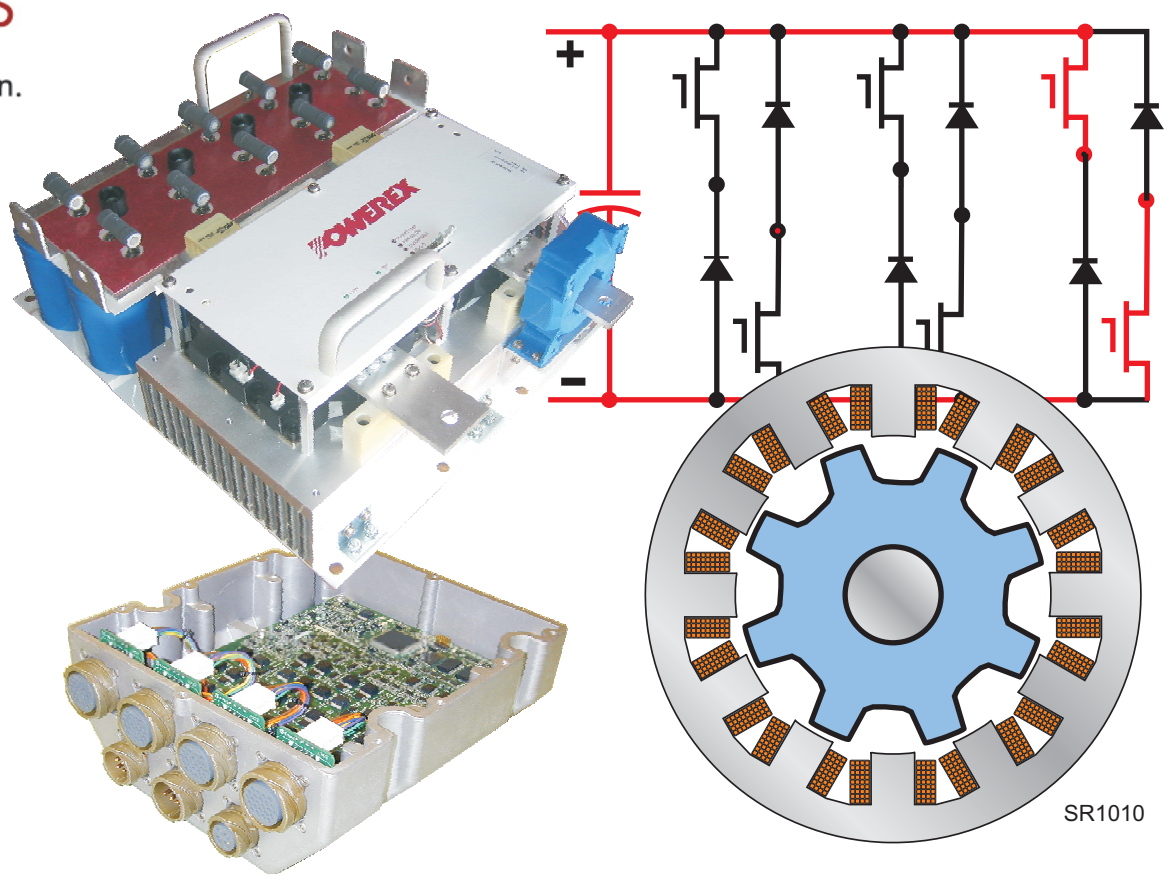
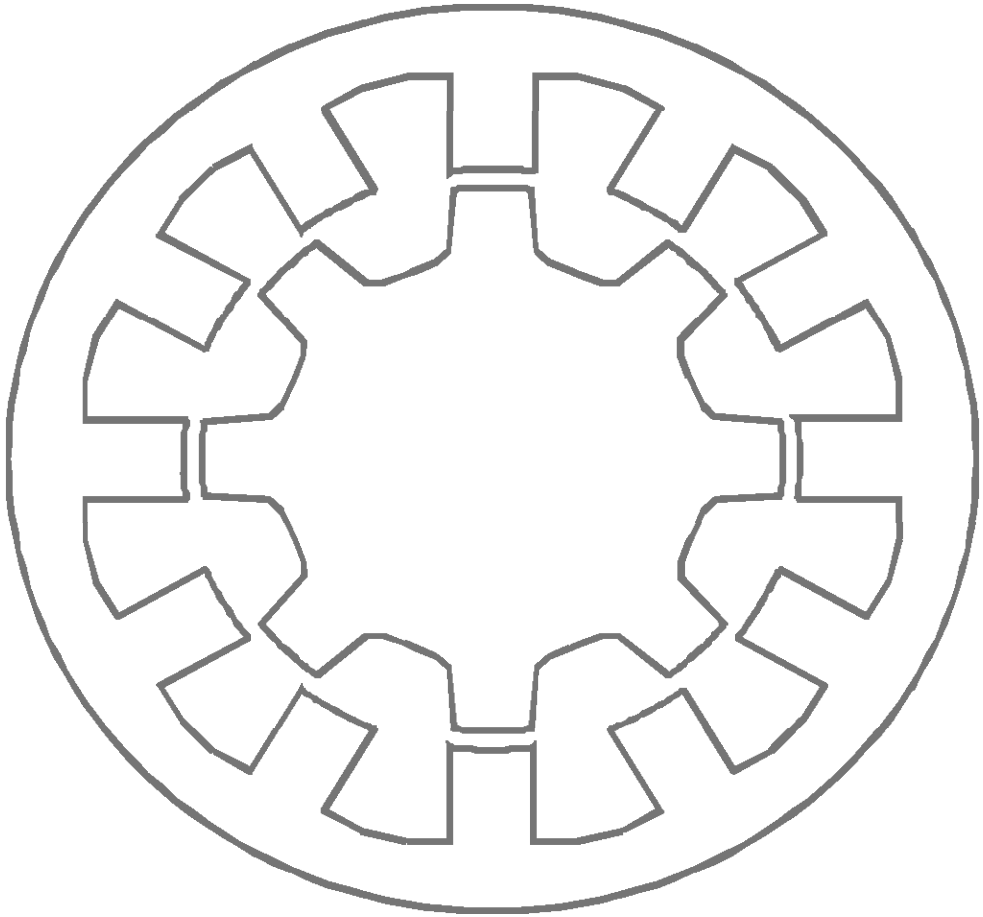
LeTourneau TECHNOLOGIES™

MINING PRODUCTS

Built On Experience. Driven By Vision.



SR Propulsion



THEORY OF OPERATION

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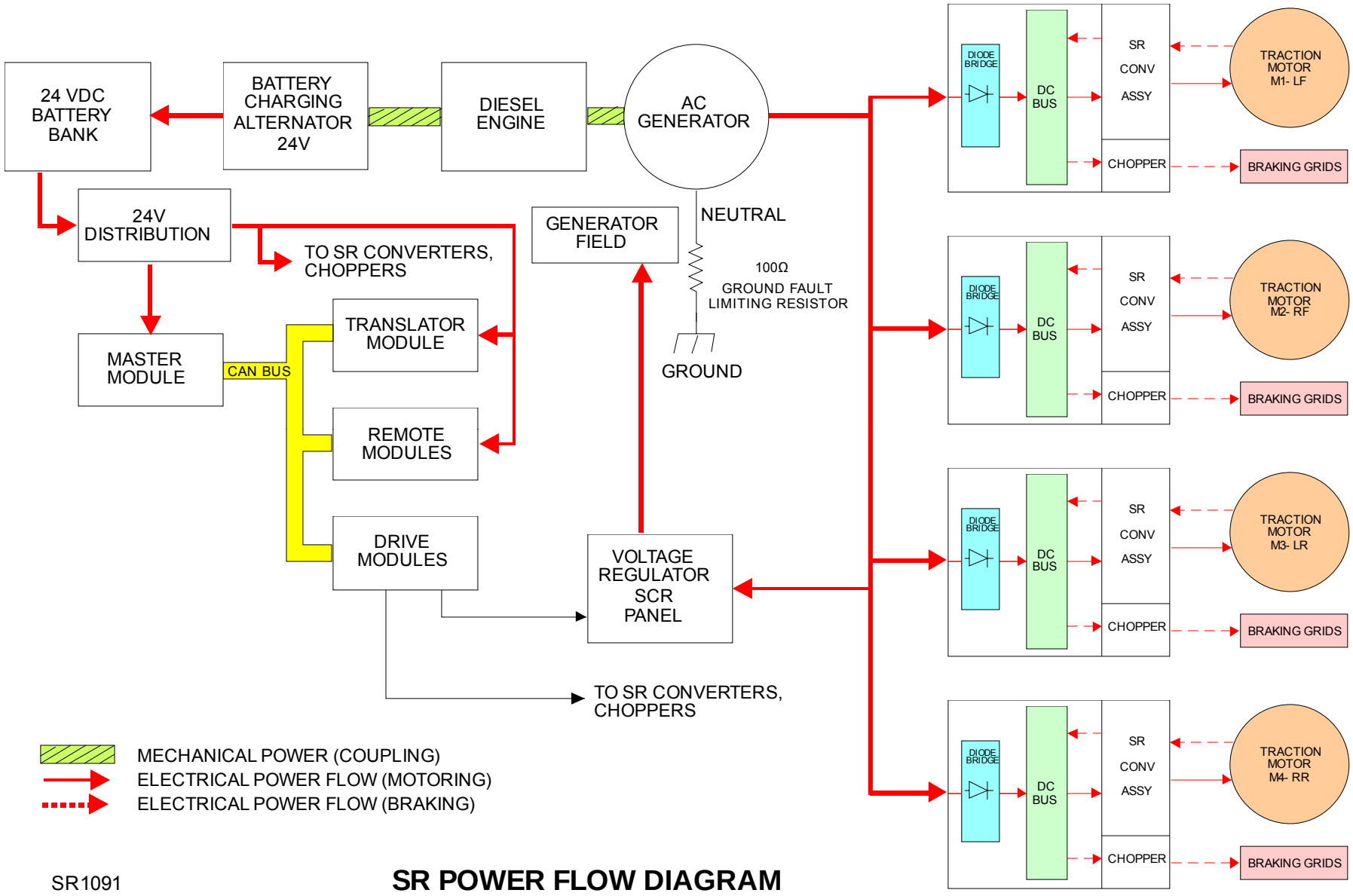
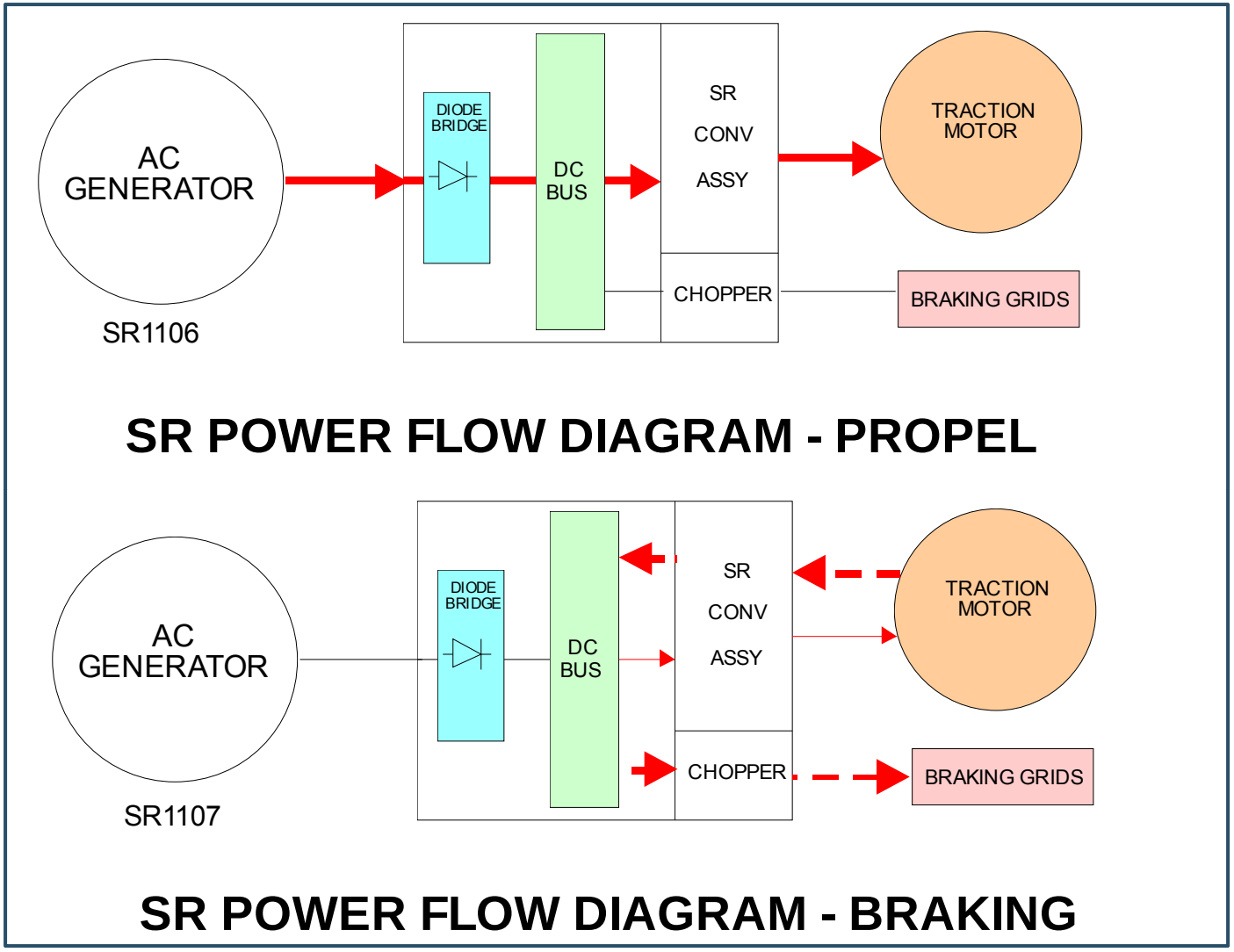


SR1091

SR POWER FLOW DIAGRAM


AC
GENERATOR
SR1106
DIODE
BRIDGE
DC
BUS
SR
CONV
ASSY
CHOPPER
TRACTION
MOTOR
BRAKING GRIDS
SR POWER FLOW DIAGRAM - PROPEL
AC
GENERATOR
SR1107
DIODE
BRIDGE
DC
BUS
SR
CONV
ASSY
CHOPPER
TRACTION
MOTOR
BRAKING GRIDS
SR POWER FLOW DIAGRAM - BRAKING

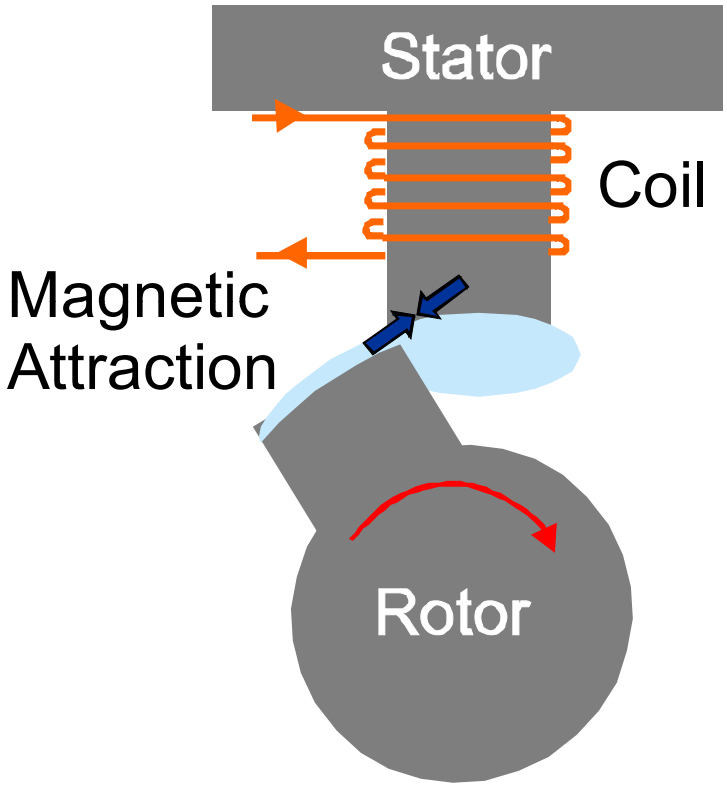
Motor System Comparisons

	DC Motor	AC Motor	SR Motor
Speed Range RPM	0 – 2,500	0 – 2,500	0 – Bearing Limit
Major Potential Failure Modes	Brushes Commutator	Squirrel cage & Power inverter switch failure	None known to date
Power Conversion	AC to controlled DC	AC to DC to VarAC	AC to on / off DC
Power Switches Control Scheme	SCR Simple	IGBT Complex	IGBT >DC but <AC
Power Efficiency	Poor power factor	Good power factor	Good power factor

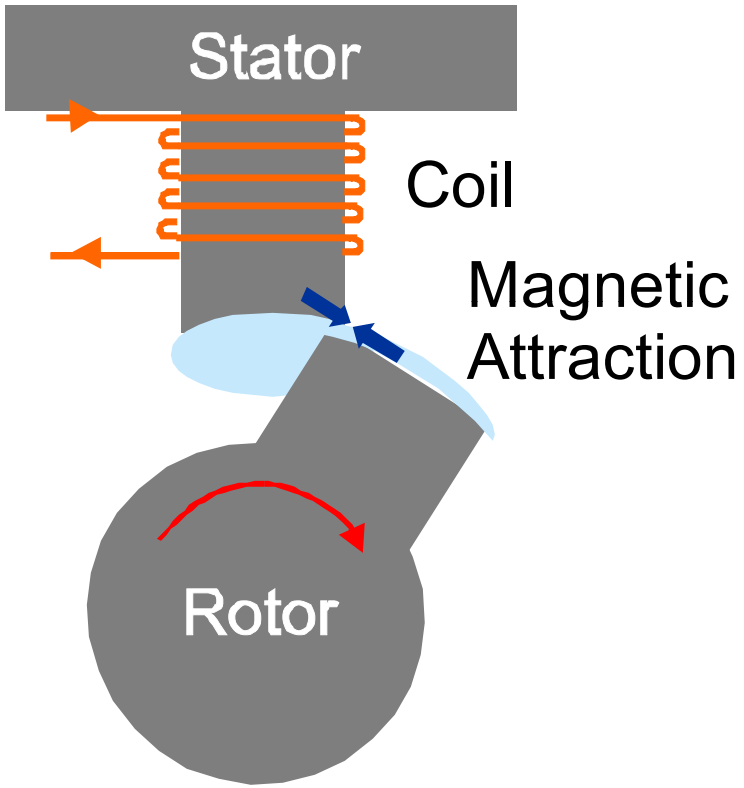
SR Motor – Features

- No Brushes or Brush Rigging
- No Commutator Maintenance
- In Fact, No Copper in the Rotor at All!
- A Simple Rotor That Is a Stack of Laminated Iron, without windings.
- A Motor That Requires no Electrical Maintenance
- Simple motor controls – immune to switching faults

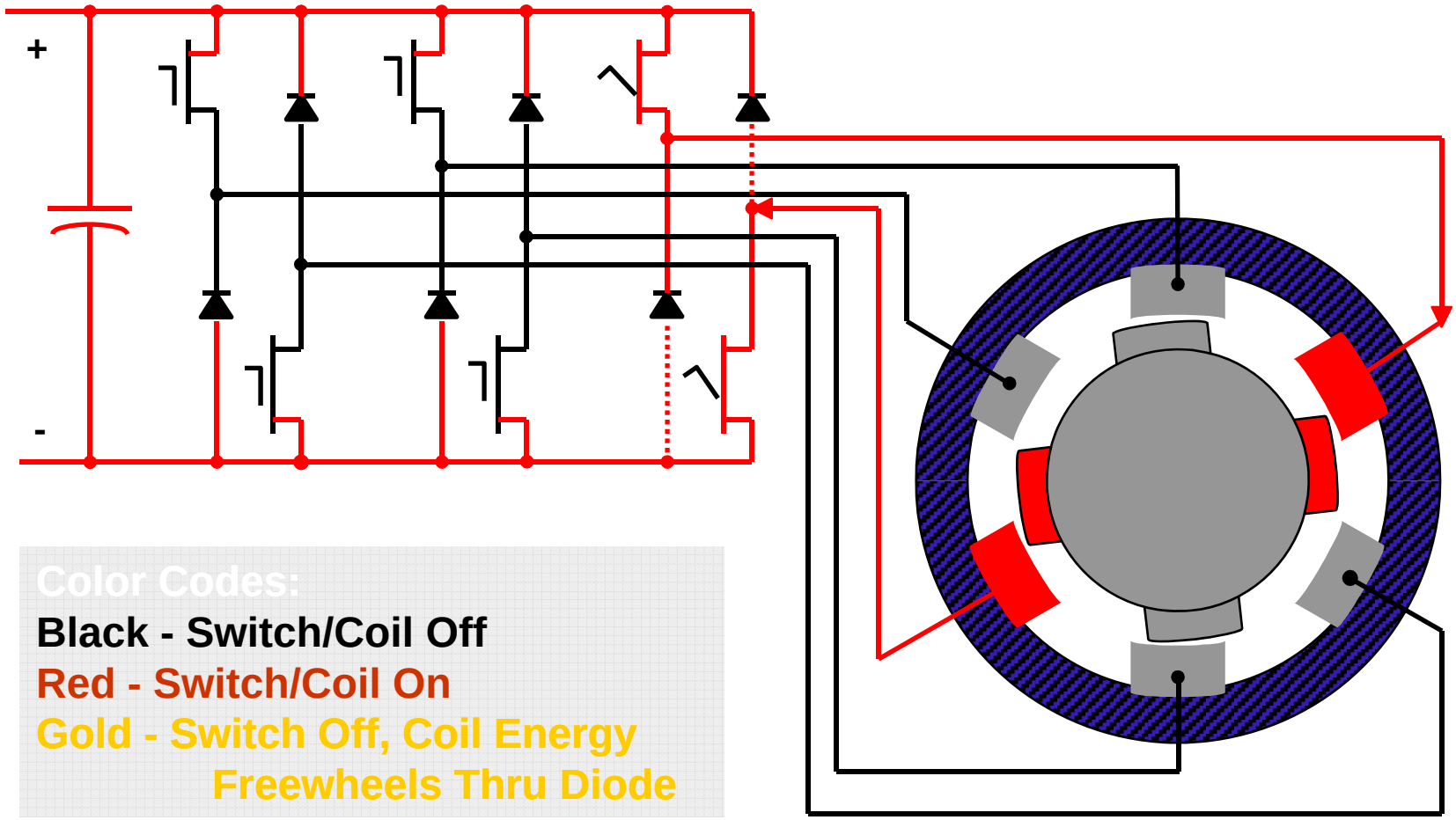
Propel



Braking



Basic Torque Production

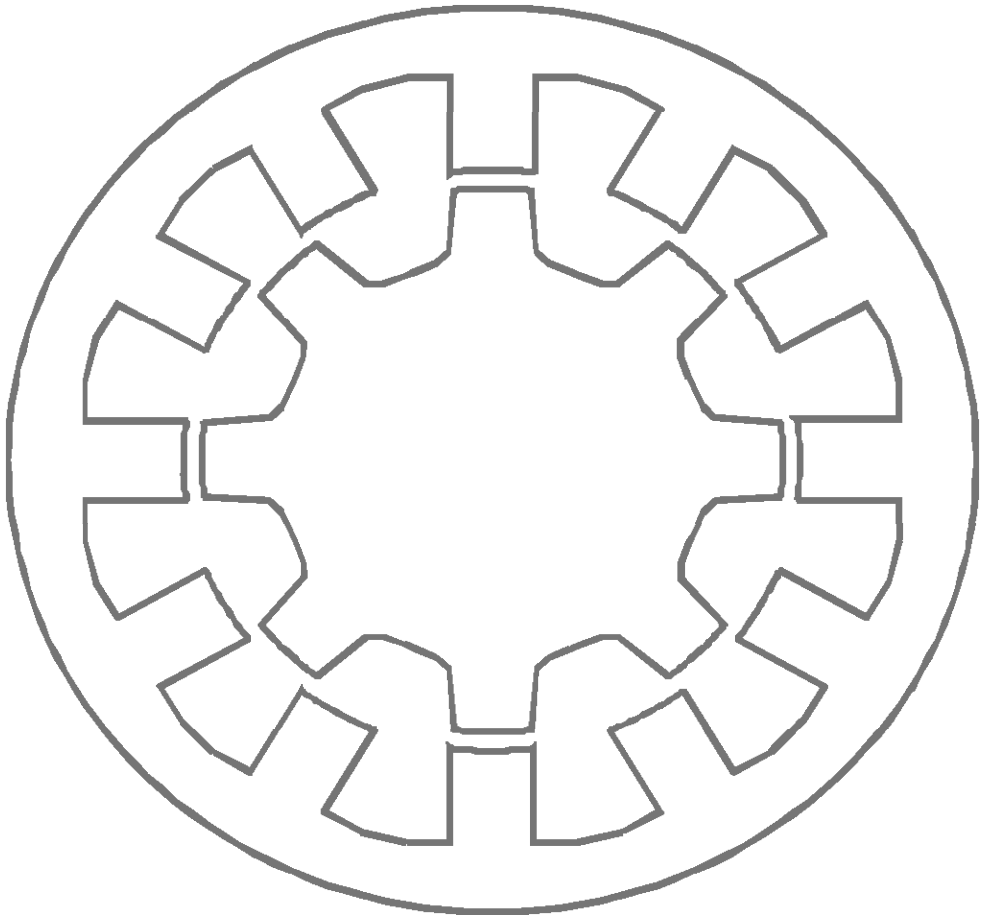


Color Codes:

Black - Switch/Coil Off

Red - Switch/Coil On

Gold - Switch Off, Coil Energy Freewheels Thru Diode



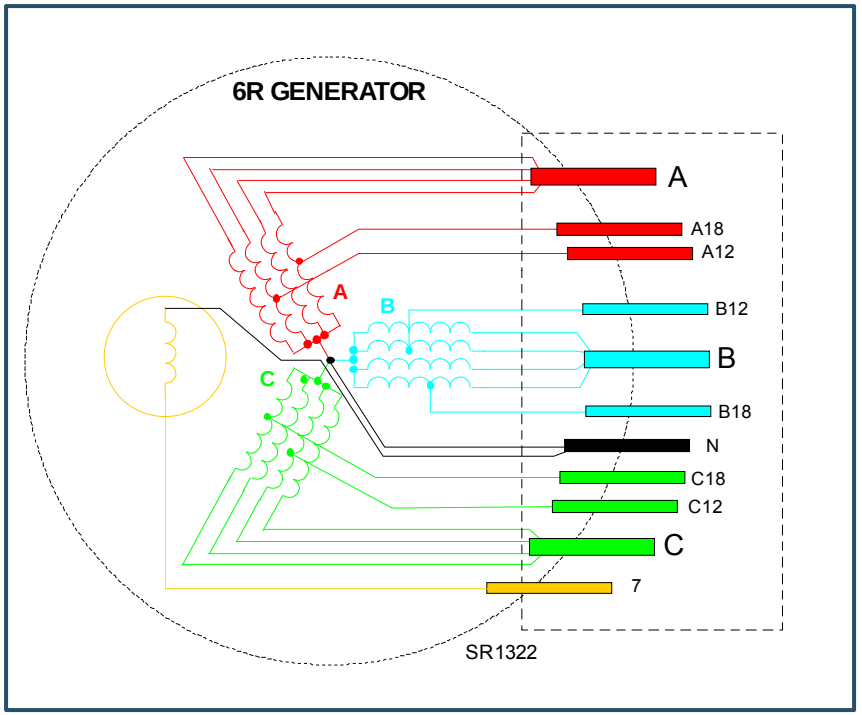
COMPONENT DESCRIPTIONS

Machine	Cummins	Detroit	HP	KW
L-950	QST30	D2000 16v	1050	783
L 1350	QSK45 (Tier 1) QSK50 (Tier 2)	D4000 12v	1600	1193

Tier 1 Detroit receives RPM Command from Engine Remote Module.
All others receive RPM Command from J1939 Bus.

Engine

SR1300



6R AC Generator (L-950)

Component Descriptions

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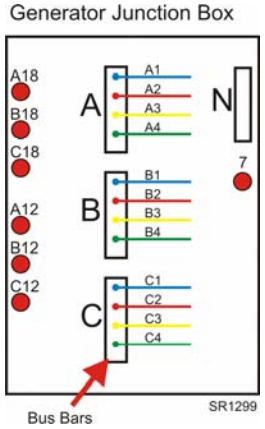
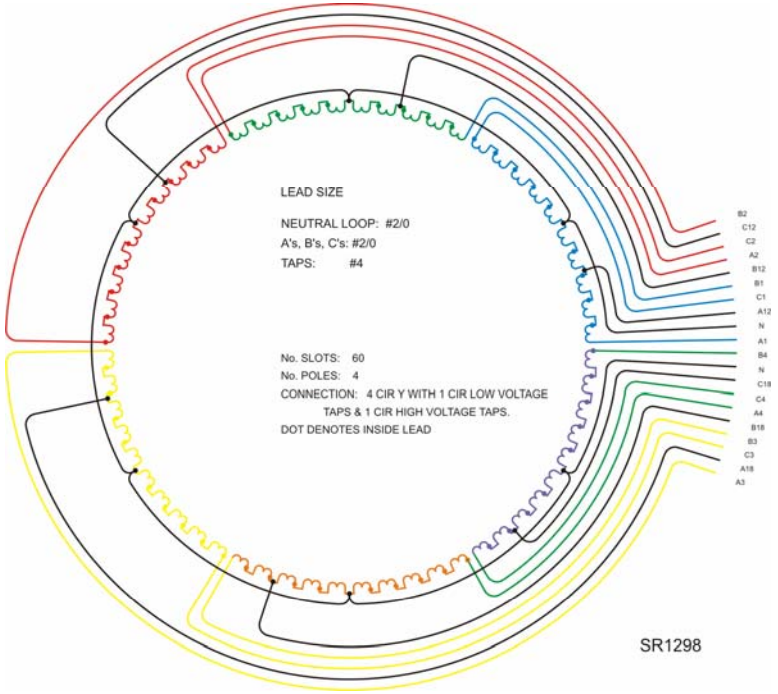
SR1316





9B AC Generator (L-1350)

Component Descriptions

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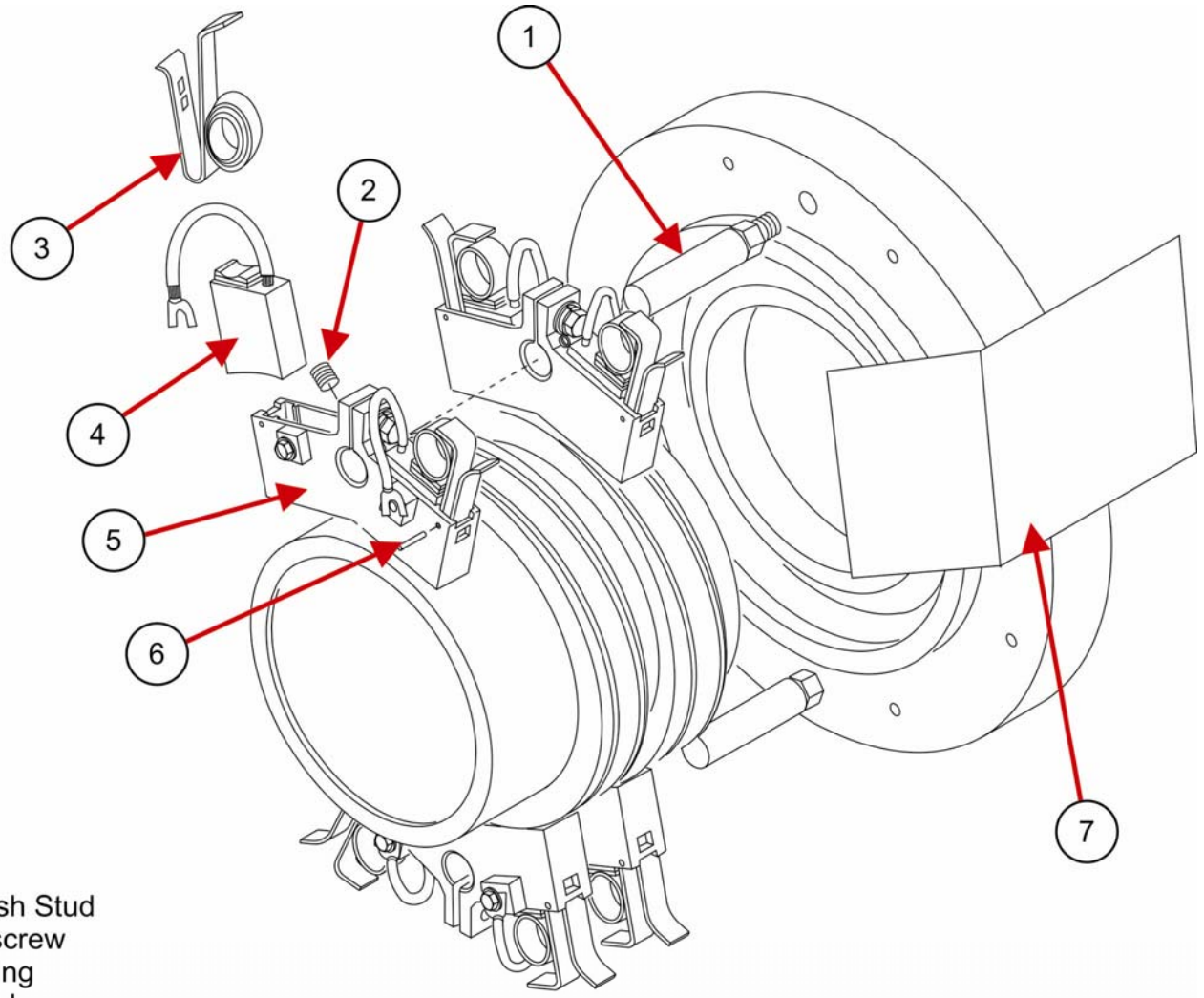
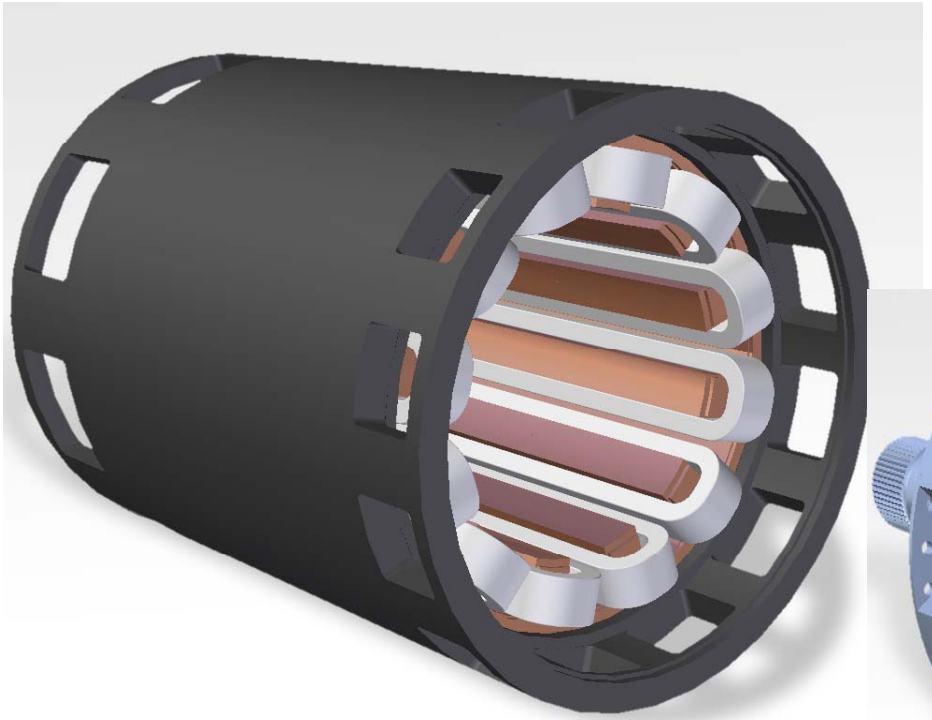
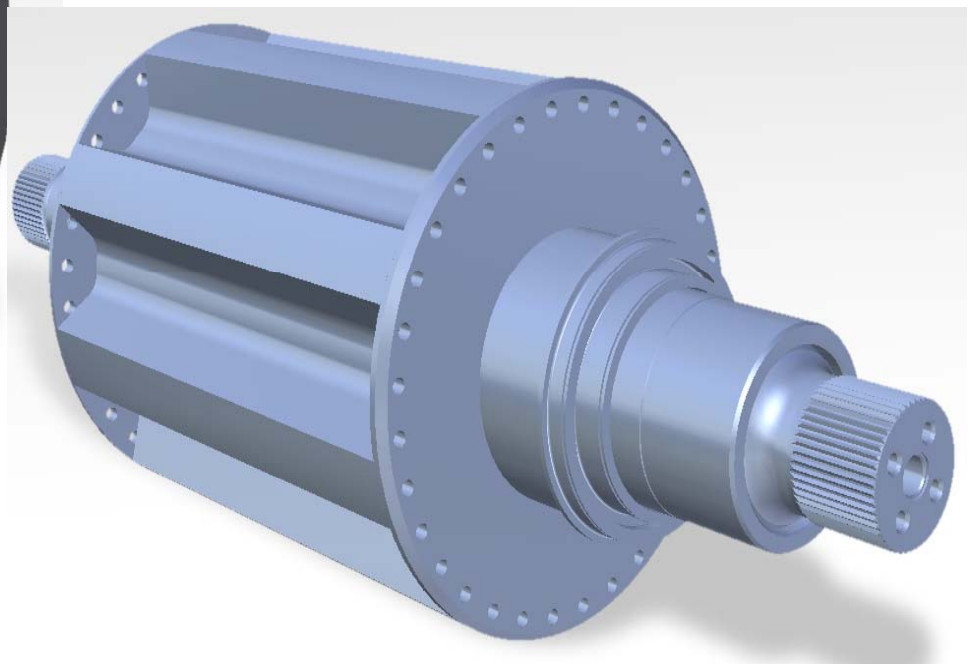


1 Brush Stud
2 setscrew
3 Spring
4 Brush
5 Brush holder assy - includes springs - DOES NOT include brushes
6 Roll pin
7 Air deflector (7 and 7B only)

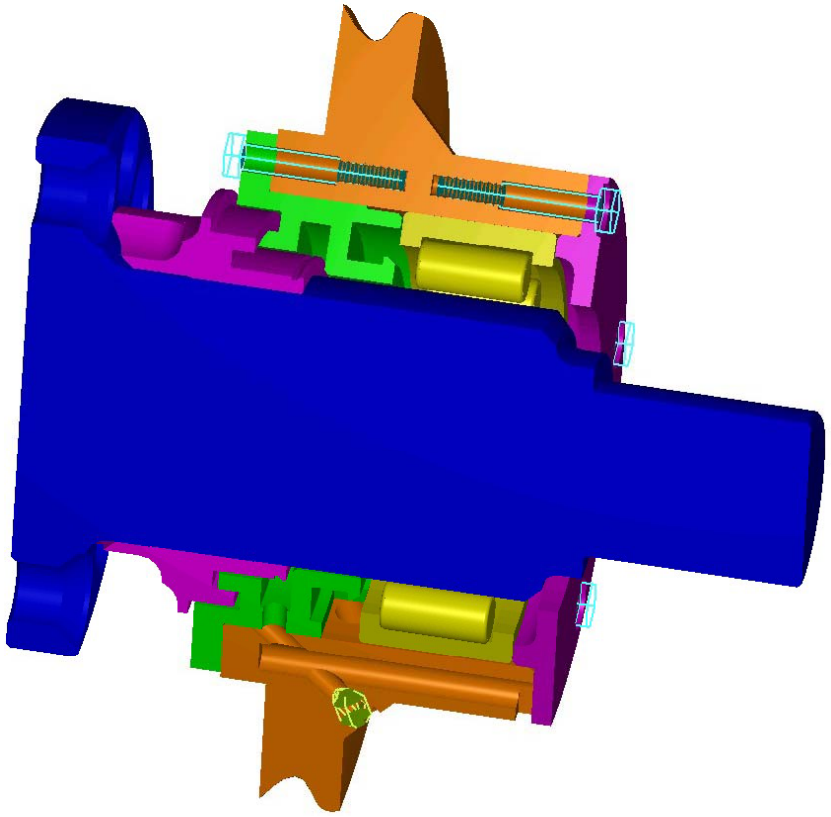


STATOR



ROTOR

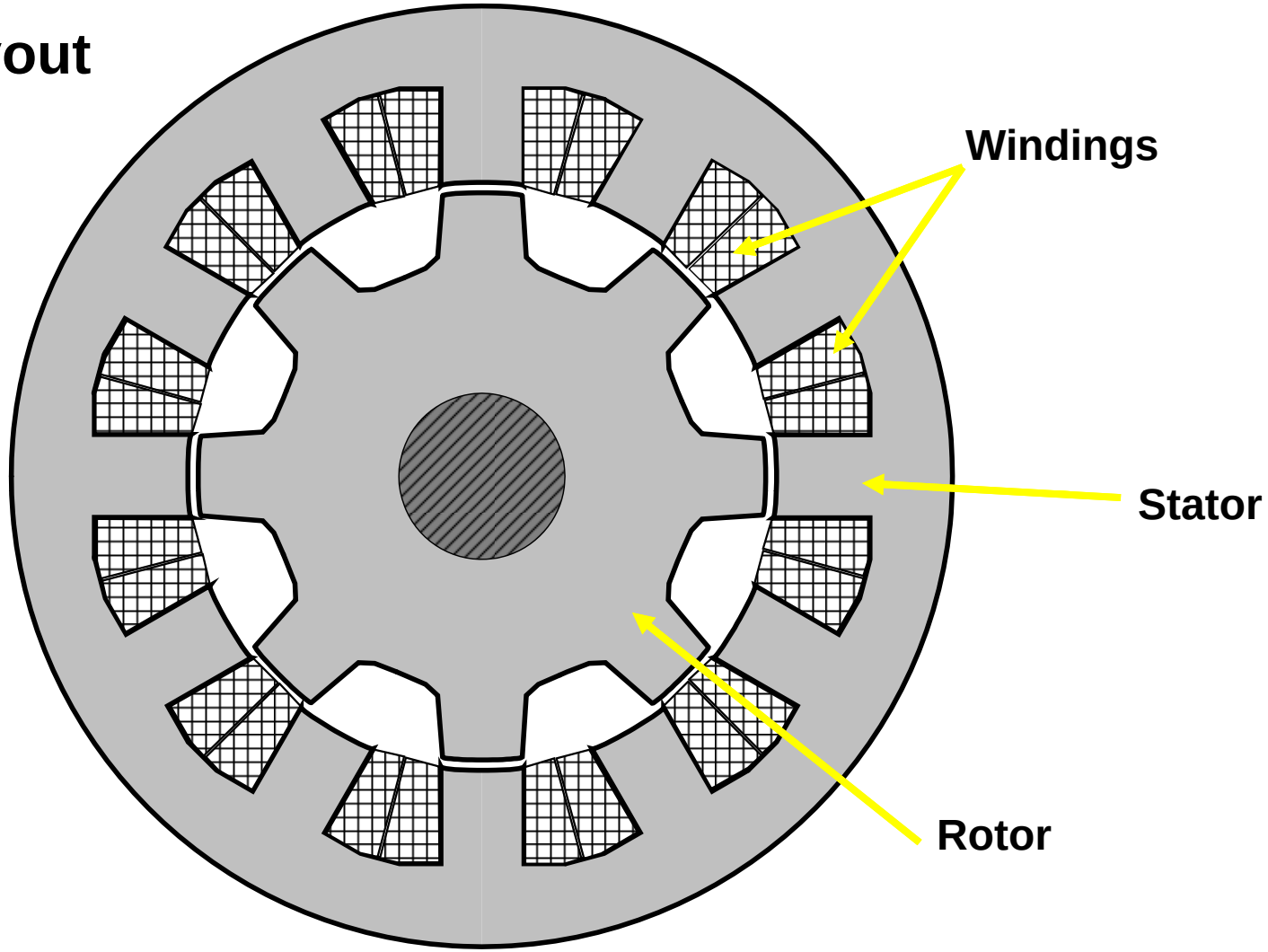
B40 SR Motor



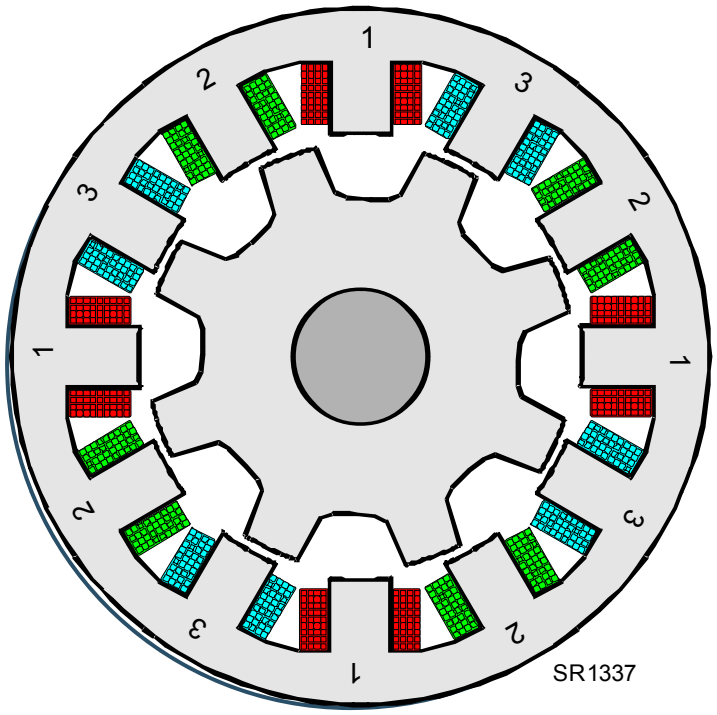
51B and 45 Drivers

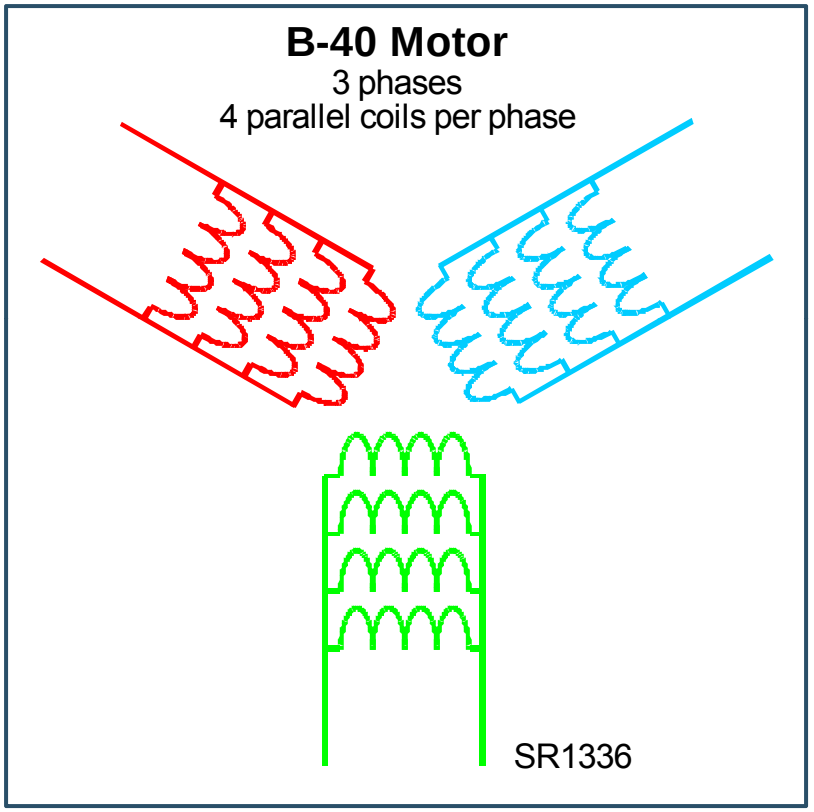
Motor Pinion End Bearing and Seals

12/8 Layout

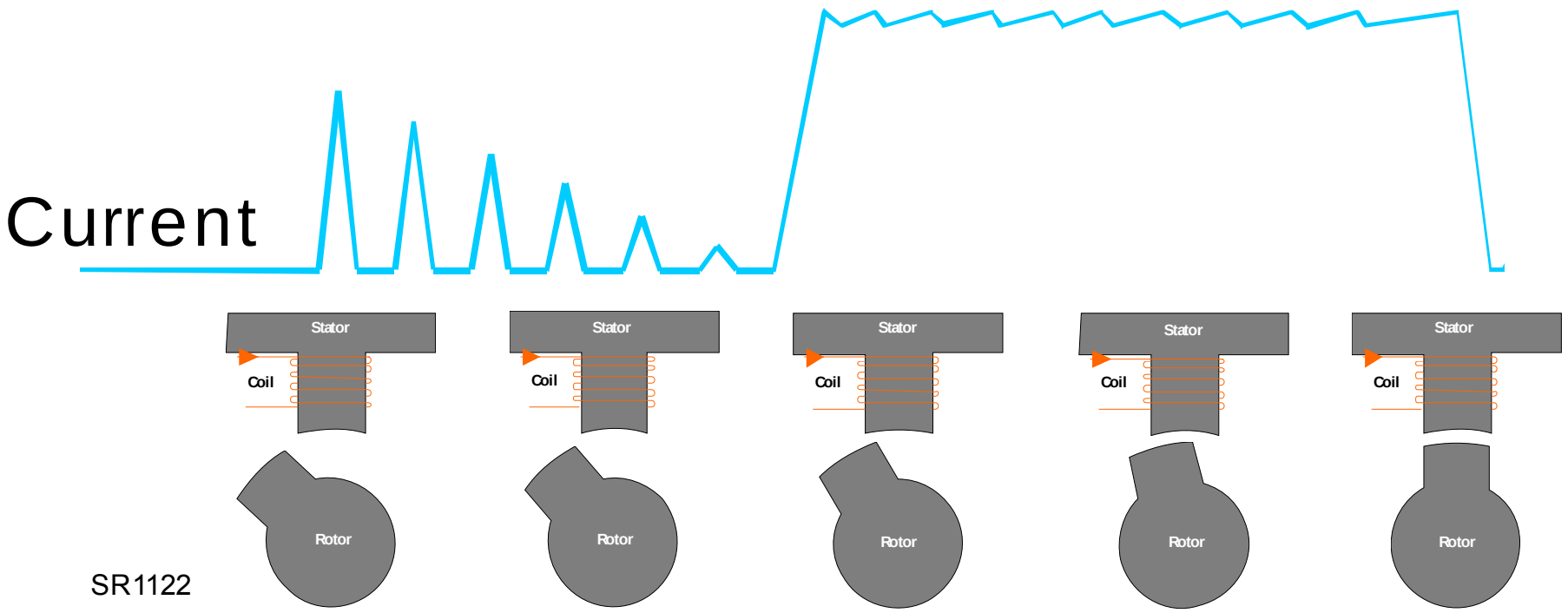


SR Motor Cross Section

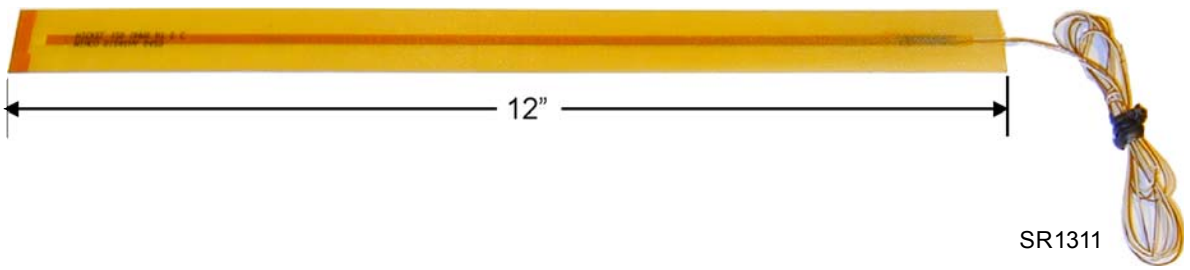


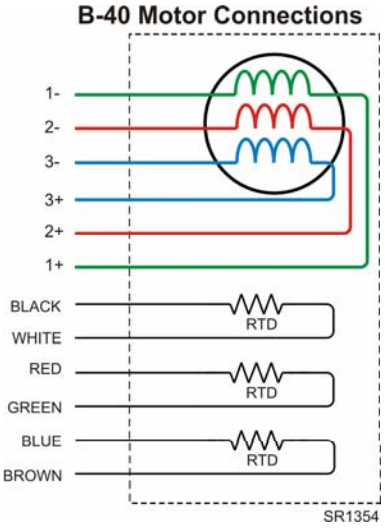


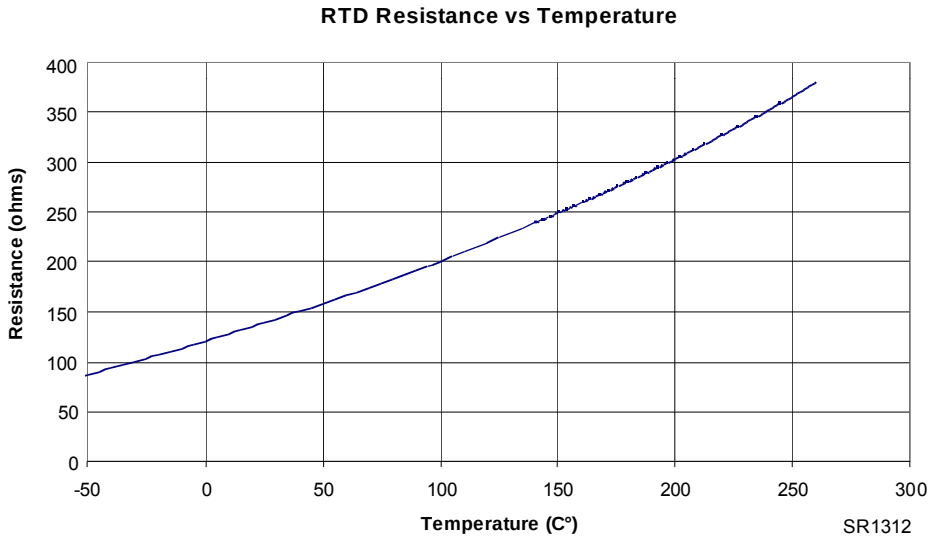
SR Motor Phase Coils



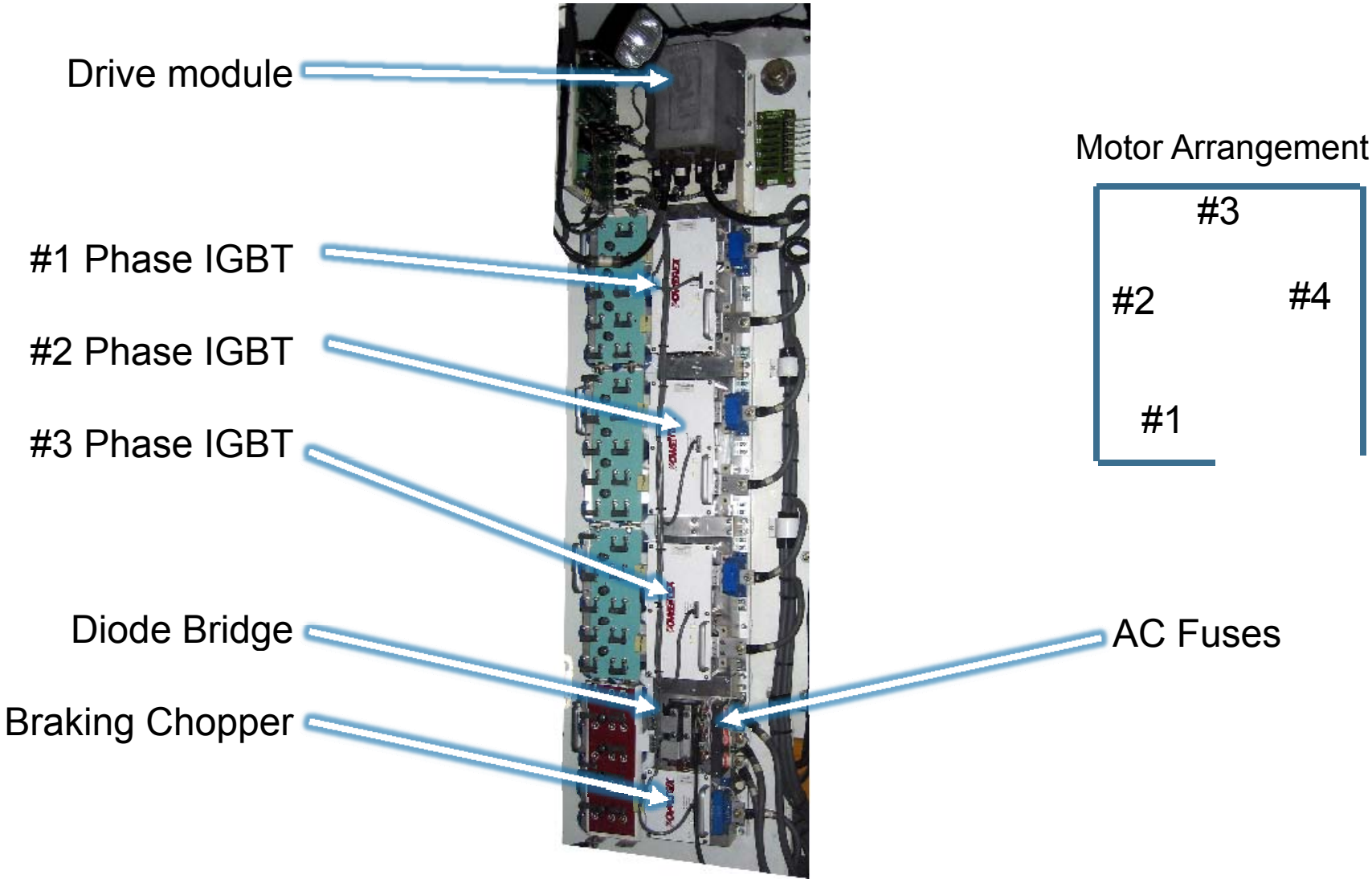
Current Flow While in Motion



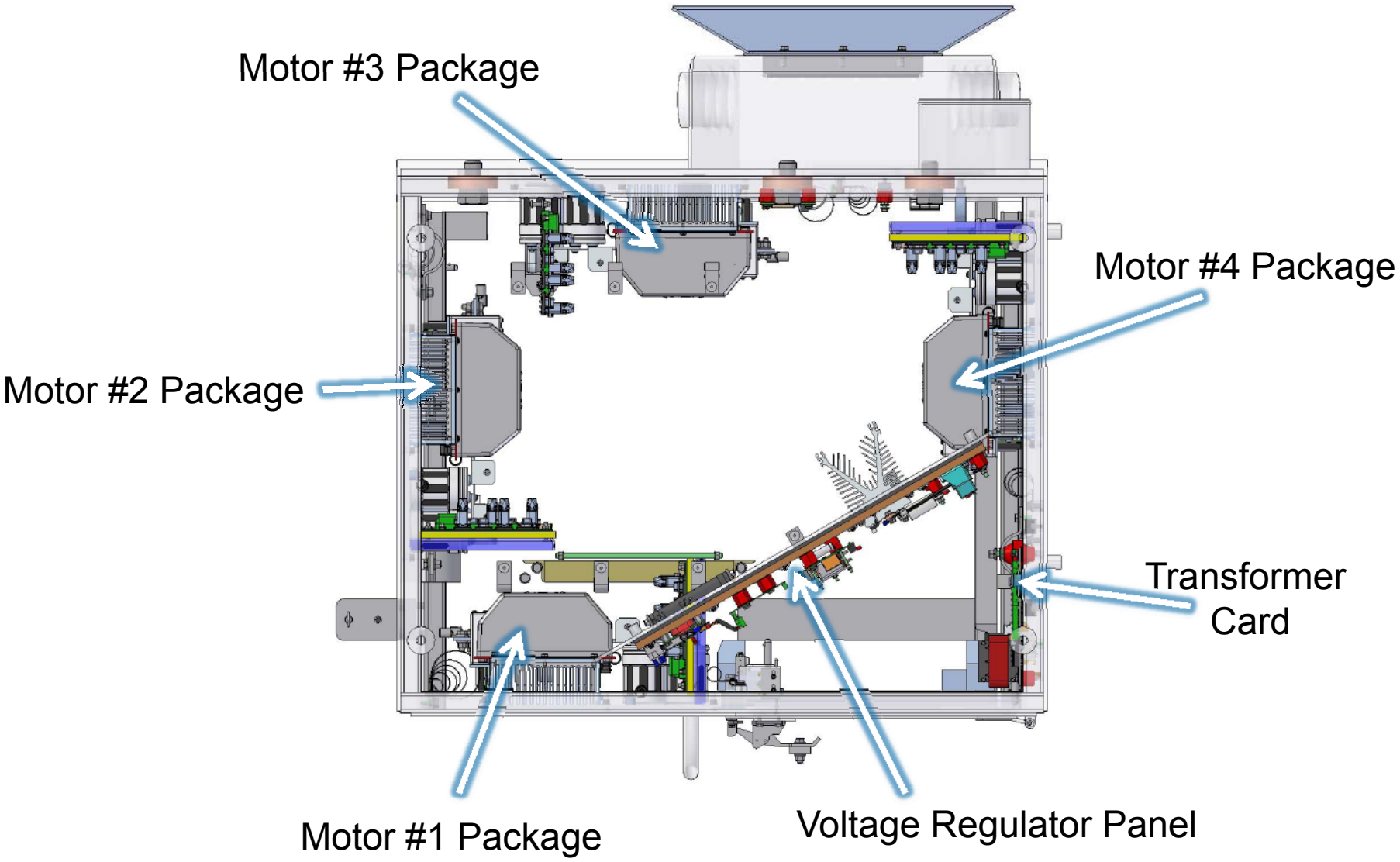




Temperature Sensing (RTD)

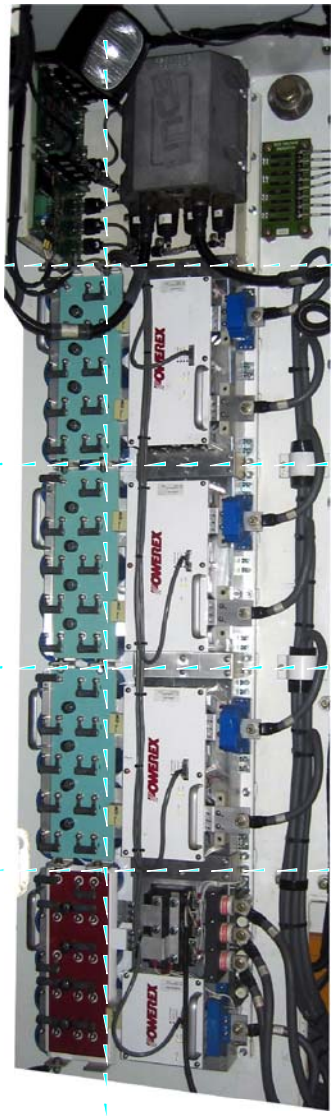


Electrical Cabinet Layout


Motor #3 Package
Motor #4 Package
Motor #2 Package
Transformer Card
Motor #1 Package
Voltage Regulator Panel

SR Motor Drive Group

(for one motor - 4 identical groups)



Interface cards
1) Interface between the IGBT panels and drive module

Drive Module
1) Converts LINCS commands into SR signals
2) Provides feedback from SR to LINCS

Bus Voltage Indication Card
1) LED's indicate the presence of Bus Voltage

IGBT Phase Panel Assy 1(A)
1) High side switch
2) Low side switch
3) Powers set of 4 parallel motor coils

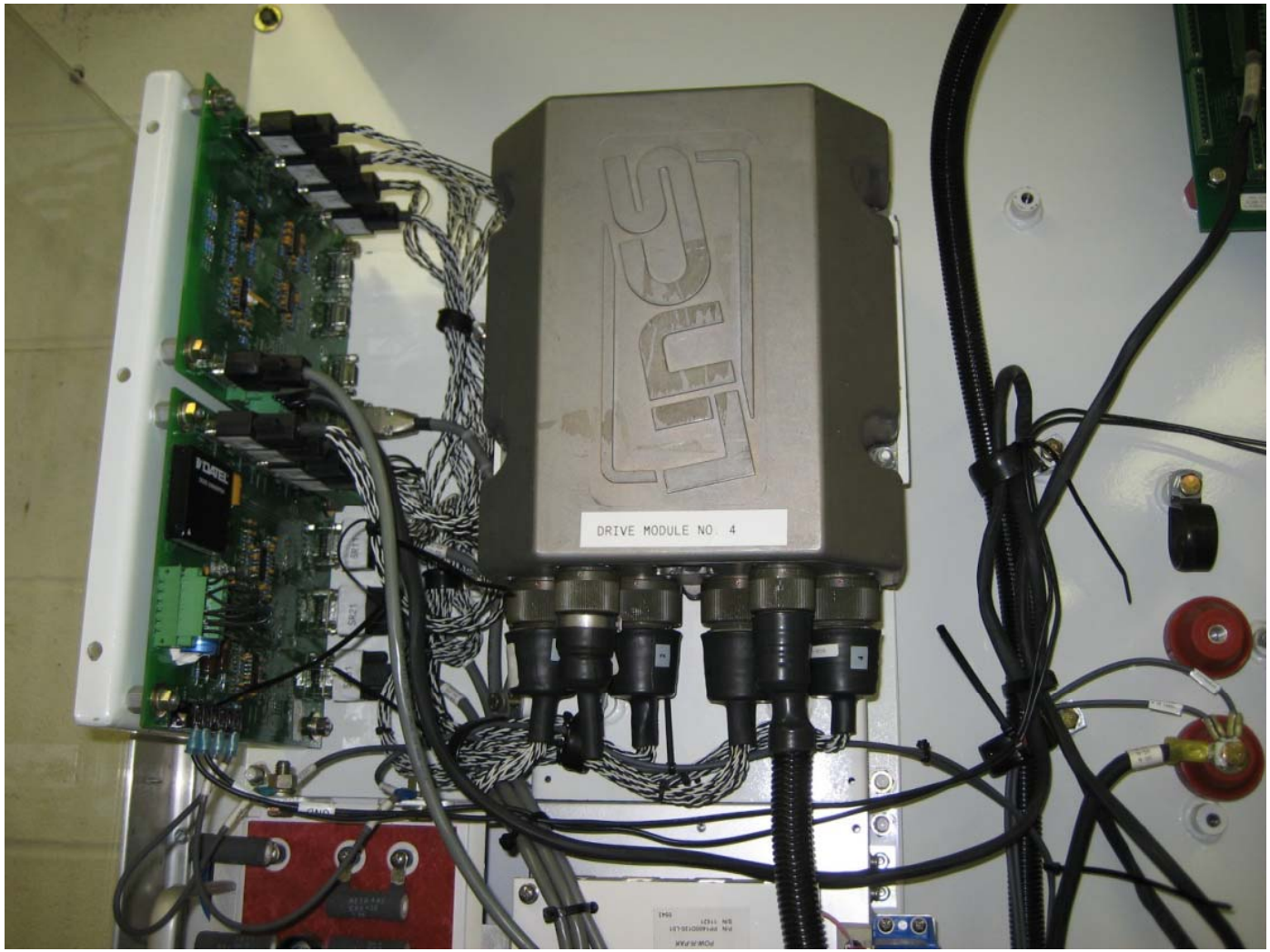
IGBT Phase Panel Assy 2(B)
1) High side switch
2) Low side switch
3) Powers set of 4 parallel motor coils

IGBT Phase Panel Assy 3(C)
1) High side switch
2) Low side switch
3) Powers set of 4 parallel motor coils

DC Bus Capacitors
(All 4 assemblies are connected together)

Chopper/Diode Panel Assembly
1) Top part is fuses and AC rectification
2) Bottom part controls power to grids

SR1270



Drive Module

Component Description

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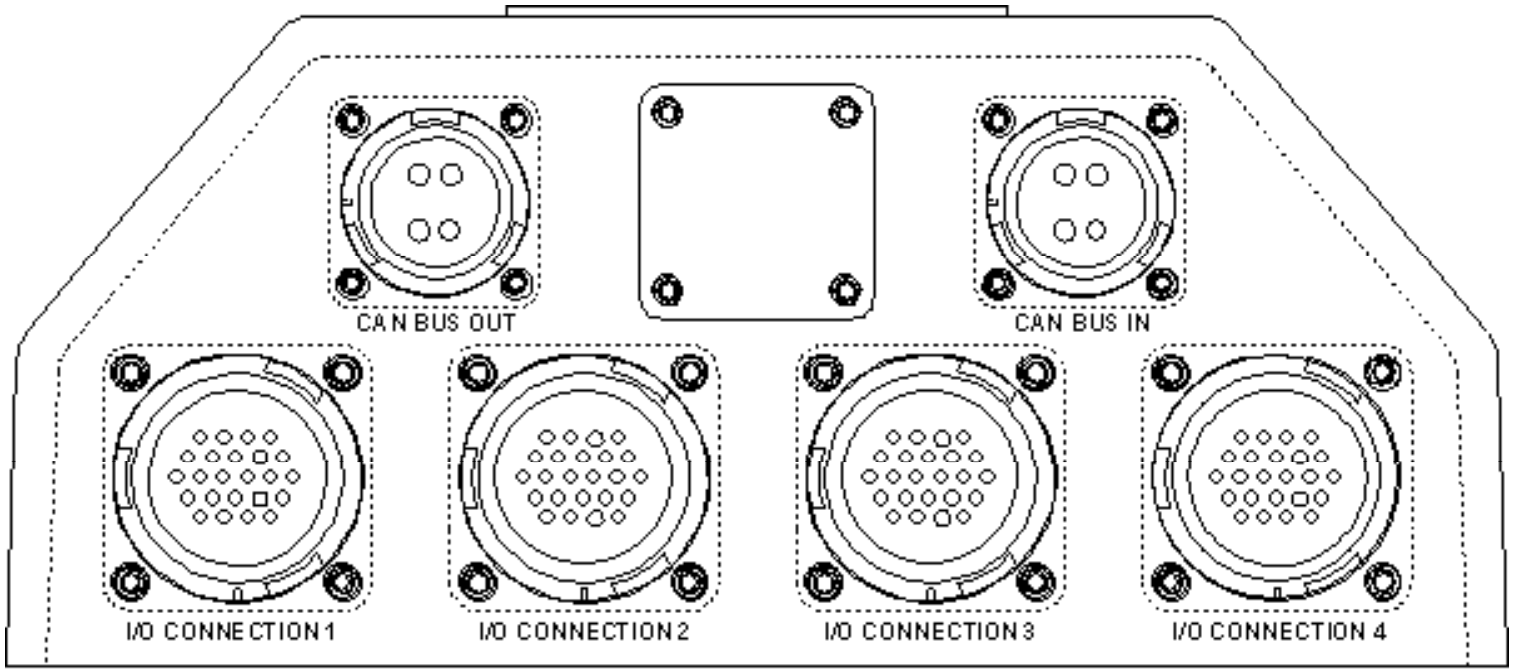
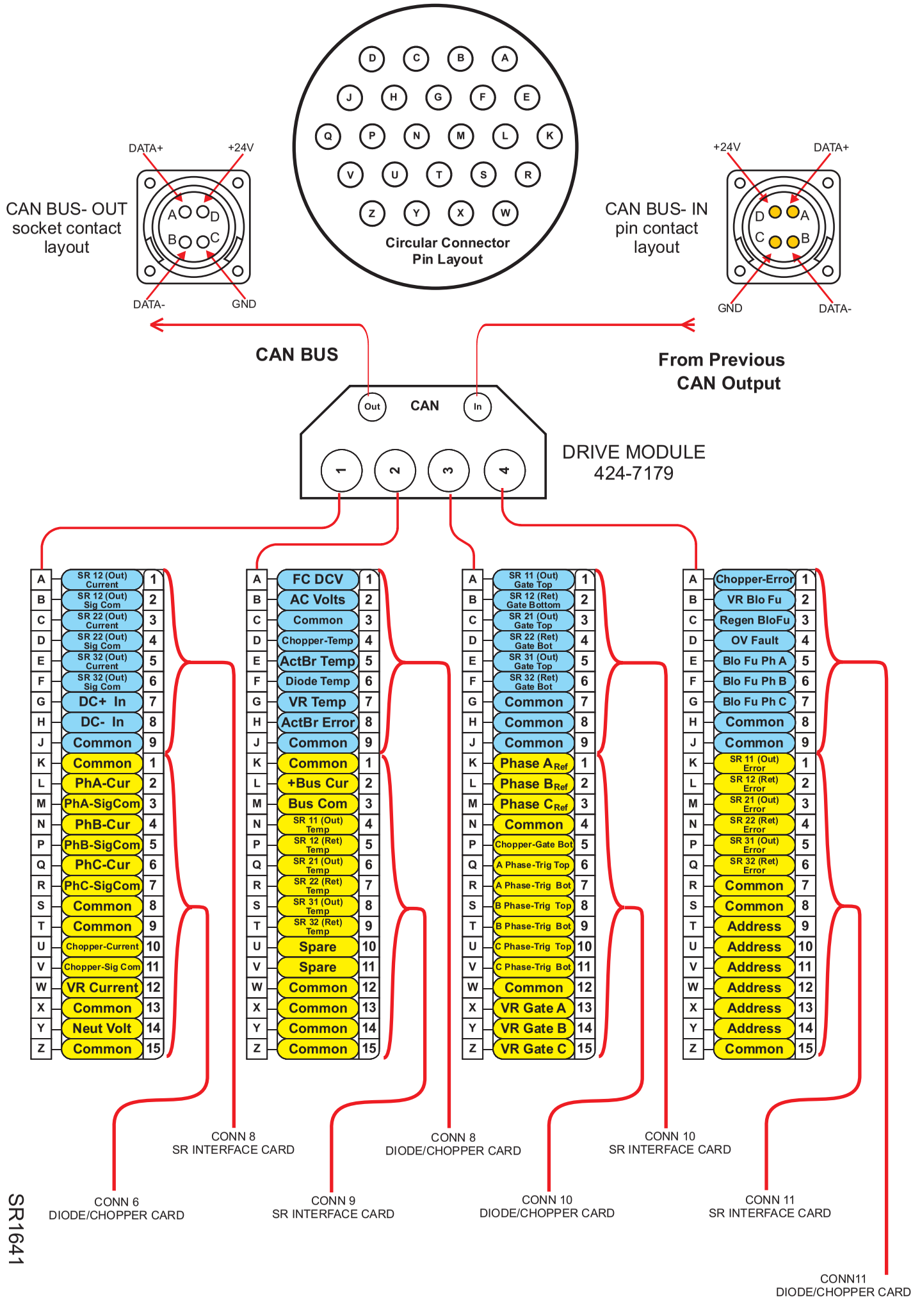


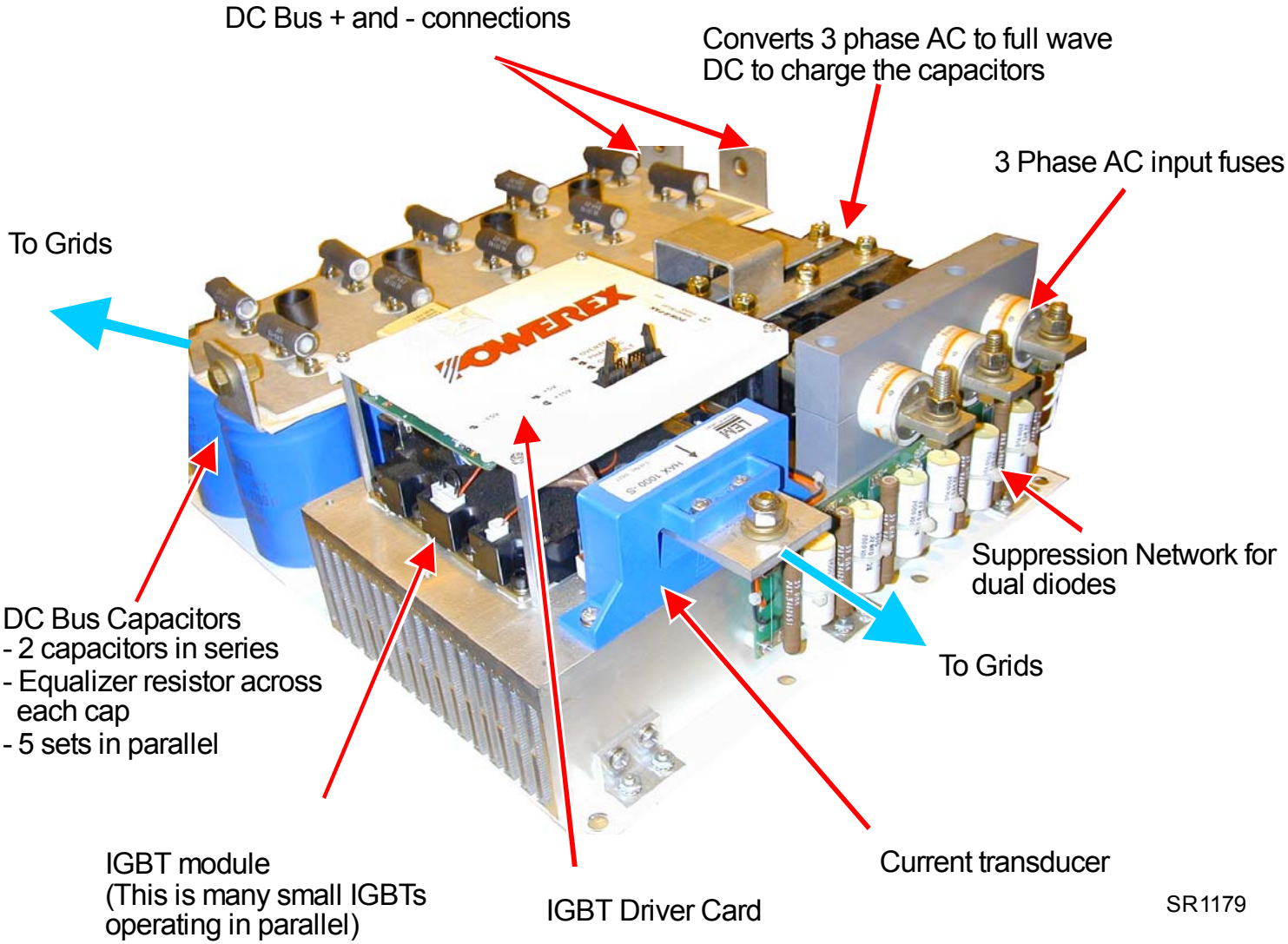
Drive Module Connectors

Component Description

LeTourneau Technologies, Inc.

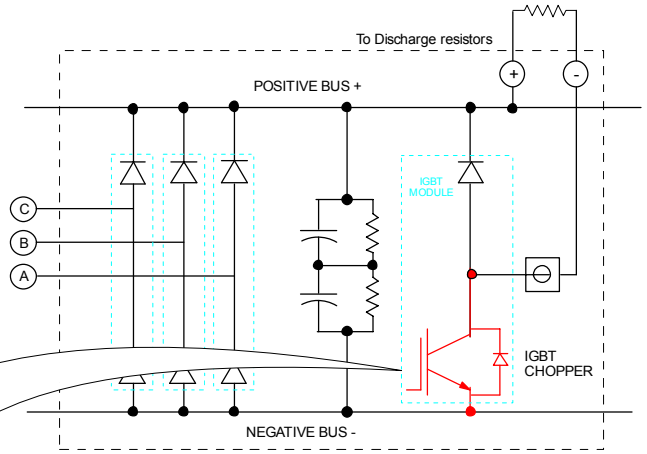

Circular Connector
Pin Layout
D C B A
J H G F E
Q P N M L K
V U T S R
Z Y X W
CAN BUS- OUT
socket contact
layout
DATA+
+24V
A D
B C
DATA-
GND
CAN BUS- IN
pin contact
layout
+24V
DATA+
D A
C B
GND
DATA-
CAN BUS
From Previous
CAN Output
Out
CAN
In
1
2
3
4
DRIVE MODULE
424-7179
A SR 12 (Out) Current 1
B SR 12 (Out) Sig Com 2
C SR 22 (Out) Current 3
D SR 22 (Out) Sig Com 4
E SR 32 (Out) Current 5
F SR 32 (Out) Sig Com 6
G DC+ In 7
H DC- In 8
J Common 9
K Common 1
L PhA-Cur 2
M PhA-SigCom 3
N PhB-Cur 4
P PhB-SigCom 5
Q PhC-Cur 6
R PhC-SigCom 7
S Common 8
T Common 9
U Chopper-Current 10
V Chopper-Sig Com 11
W VR Current 12
X Common 13
Y Neut Volt 14
Z Common 15
A FC DCV 1
B AC Volts 2
C Common 3
D Chopper-Temp 4
E ActBr Temp 5
F Diode Temp 6
G VR Temp 7
H ActBr Error 8
J Common 9
K Common 1
L +Bus Cur 2
M Bus Com 3
N SR 11 (Out) Temp 4
P SR 12 (Ret) Temp 5
Q SR 21 (Out) Temp 6
R SR 22 (Ret) Temp 7
S SR 31 (Out) Temp 8
T SR 32 (Ret) Temp 9
U Spare 10
V Spare 11
W Common 12
X Common 13
Y Common 14
Z Common 15
A SR 11 (Out) Gate Top 1
B SR 12 (Ret) Gate Bottom 2
C SR 21 (Out) Gate Top 3
D SR 22 (Ret) Gate Bot 4
E SR 31 (Out) Gate Top 5
F SR 32 (Ret) Gate Bot 6
G Common 7
H Common 8
J Common 9
K Phase A Ref 1
L Phase B Ref 2
M Phase C Ref 3
N Common 4
P Chopper-Gate Bot 5
Q A Phase-Trig Top 6
R A Phase-Trig Bot 7
S B Phase-Trig Top 8
T B Phase-Trig Bot 9
U C Phase-Trig Top 10
V C Phase-Trig Bot 11
W Common 12
X VR Gate A 13
Y VR Gate B 14
Z VR Gate C 15
A Chopper-Error 1
B VR Blo Fu 2
C Regen BloFu 3
D OV Fault 4
E Blo Fu Ph A 5
F Blo Fu Ph B 6
G Blo Fu Ph C 7
H Common 8
J Common 9
K SR 11 (Out) Error 1
L SR 12 (Ret) Error 2
M SR 21 (Out) Error 3
N SR 22 (Ret) Error 4
P SR 31 (Out) Error 5
Q SR 32 (Ret) Error 6
R Common 7
S Common 8
T Address 9
U Address 10
V Address 11
W Address 12
X Address 13
Y Address 14
Z Common 15
CONN 6
DIODE/CHOPPER CARD
CONN 8
SR INTERFACE CARD
CONN 9
SR INTERFACE CARD
CONN 8
DIODE/CHOPPER CARD
CONN 10
DIODE/CHOPPER CARD
CONN 10
SR INTERFACE CARD
CONN 11
SR INTERFACE CARD
CONN11
DIODE/CHOPPER CARD
SR1641

Chopper Panel



Chopper Panel

Inside of 900A IGBT module

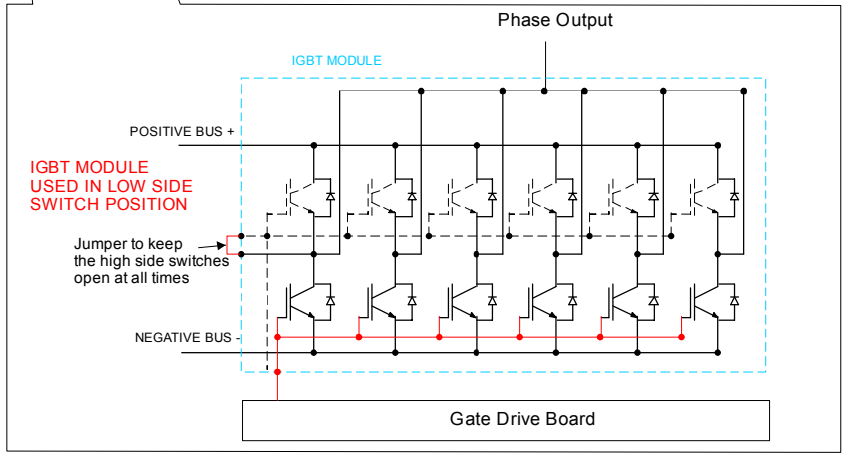


IGBT module

Each IGBT module used on the 950 and 1350 Braking Chopper internally consists of 6 small high side and 6 low side IGBT switches and related diodes.

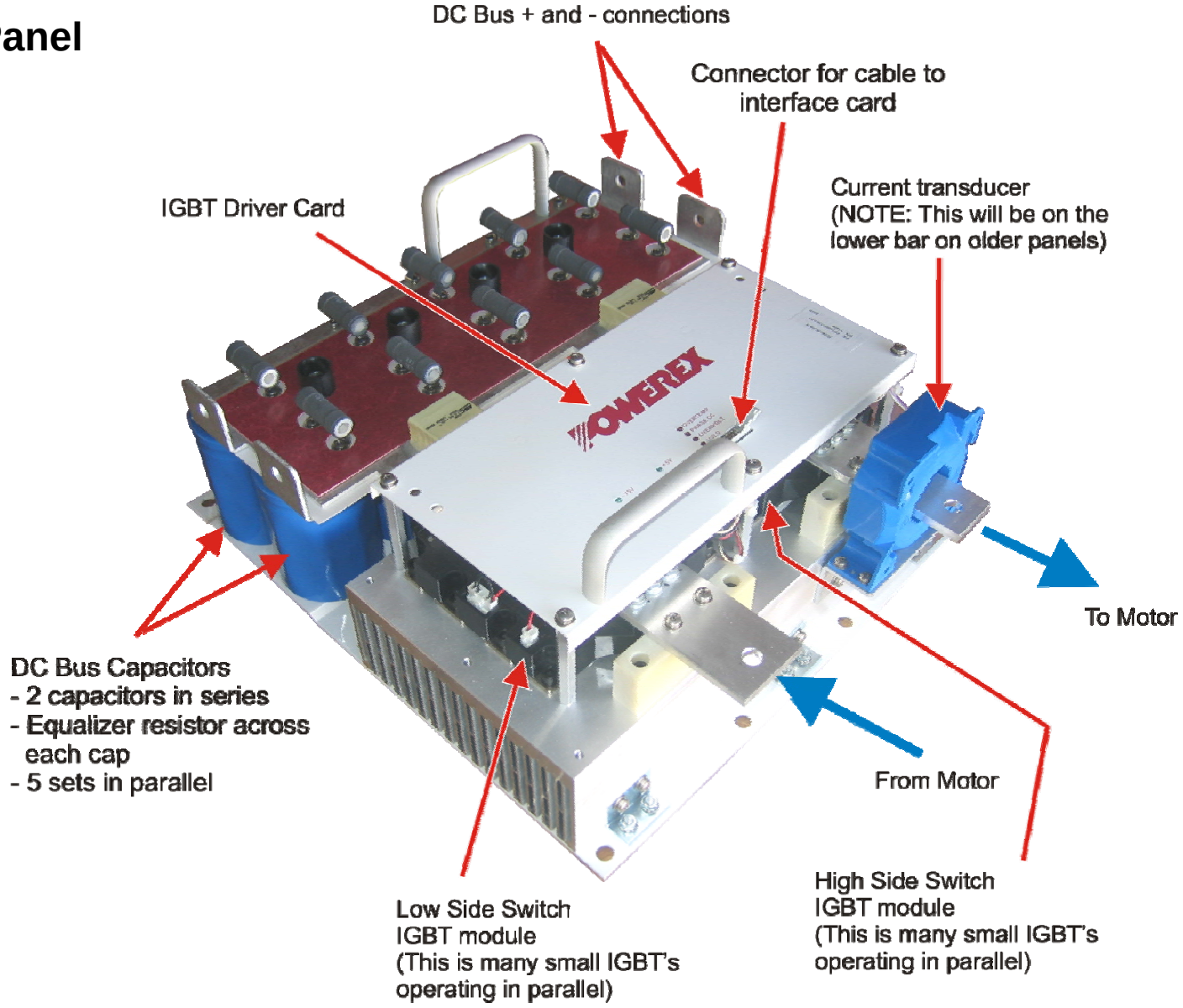
The high and low side IGBT's are operated in parallel by the Gate Drive board on the panel assembly.

In this location - only the low side switches are used as shown.



SR1248

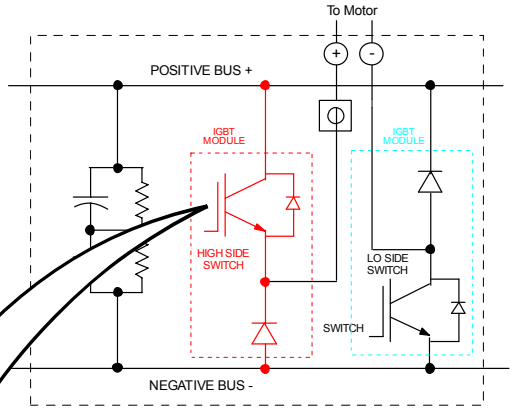
Phase Panel


DC Bus + and - connections
Connector for cable to interface card
IGBT Driver Card
Current transducer (NOTE: This will be on the lower bar on older panels)
To Motor
DC Bus Capacitors
- 2 capacitors in series
- Equalizer resistor across each cap
- 5 sets in parallel
From Motor
Low Side Switch IGBT module (This is many small IGBT's operating in parallel)
High Side Switch IGBT module (This is many small IGBT's operating in parallel)

Phase Panel

Phase Panel

Inside of 900A IGBT module
(1400A has the empty spaces
filled up)



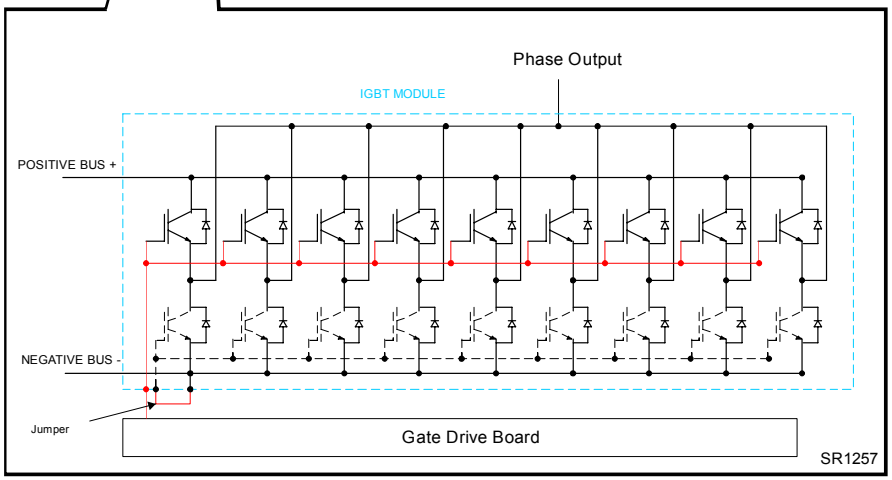
IGBT module

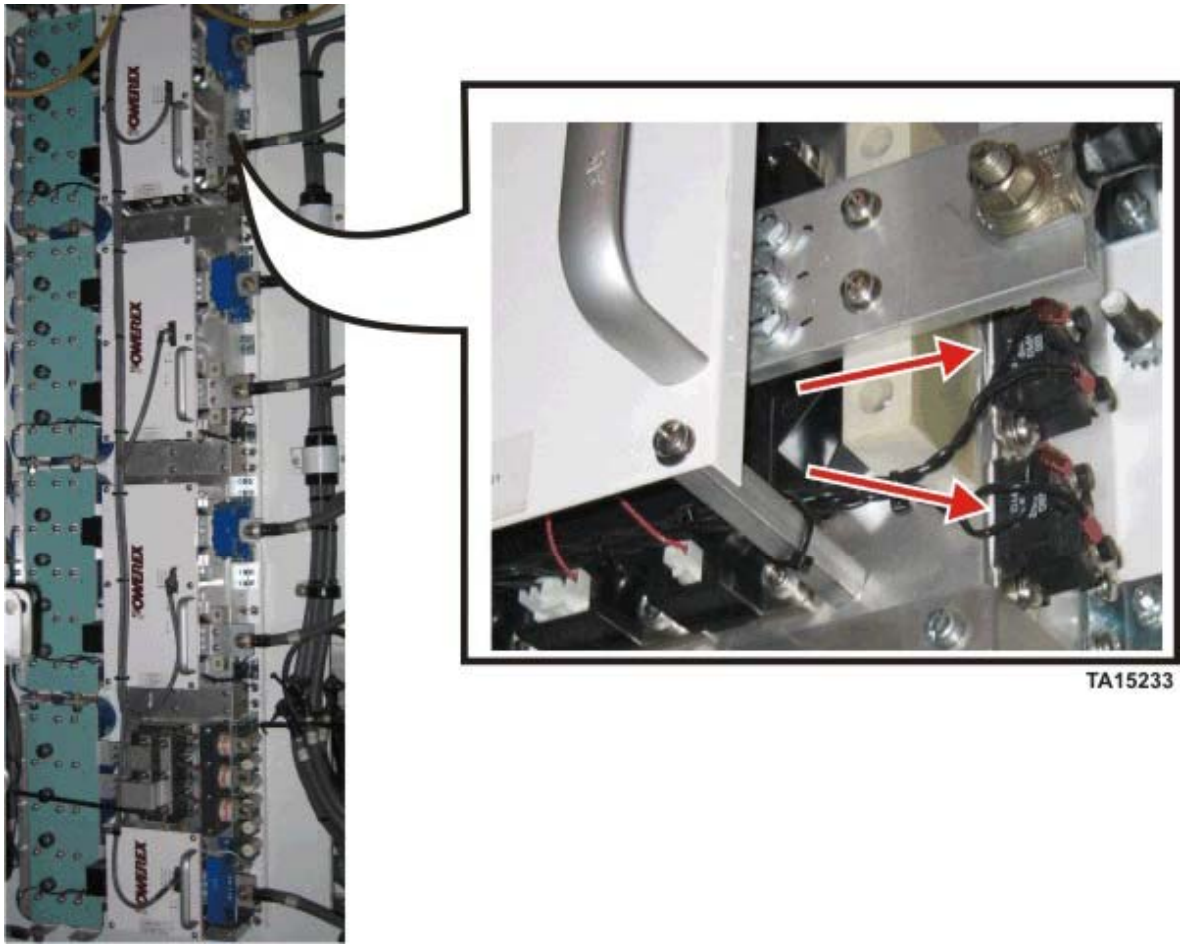
Each 900A module (950) internally consists of 6 small high side and 6 low side IGBT switches and related diodes.

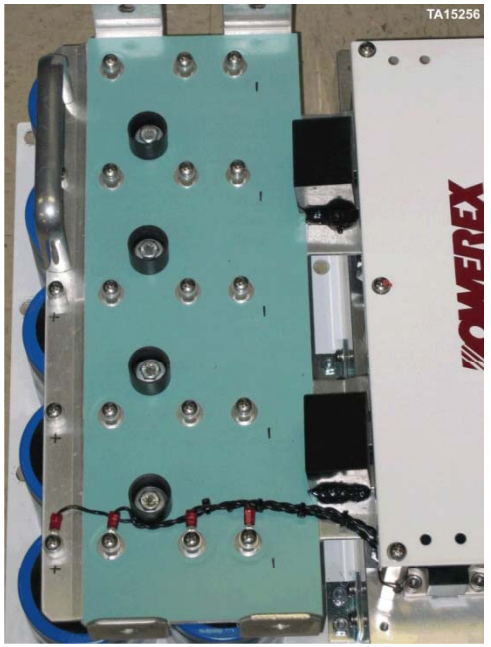
Each 1400A module (1350) internally consists of 9 small high side and 9 low side IGBT switches and related diodes.

The high and low side IGBTs are operated in parallel by the Gate Drive board on the panel assembly.

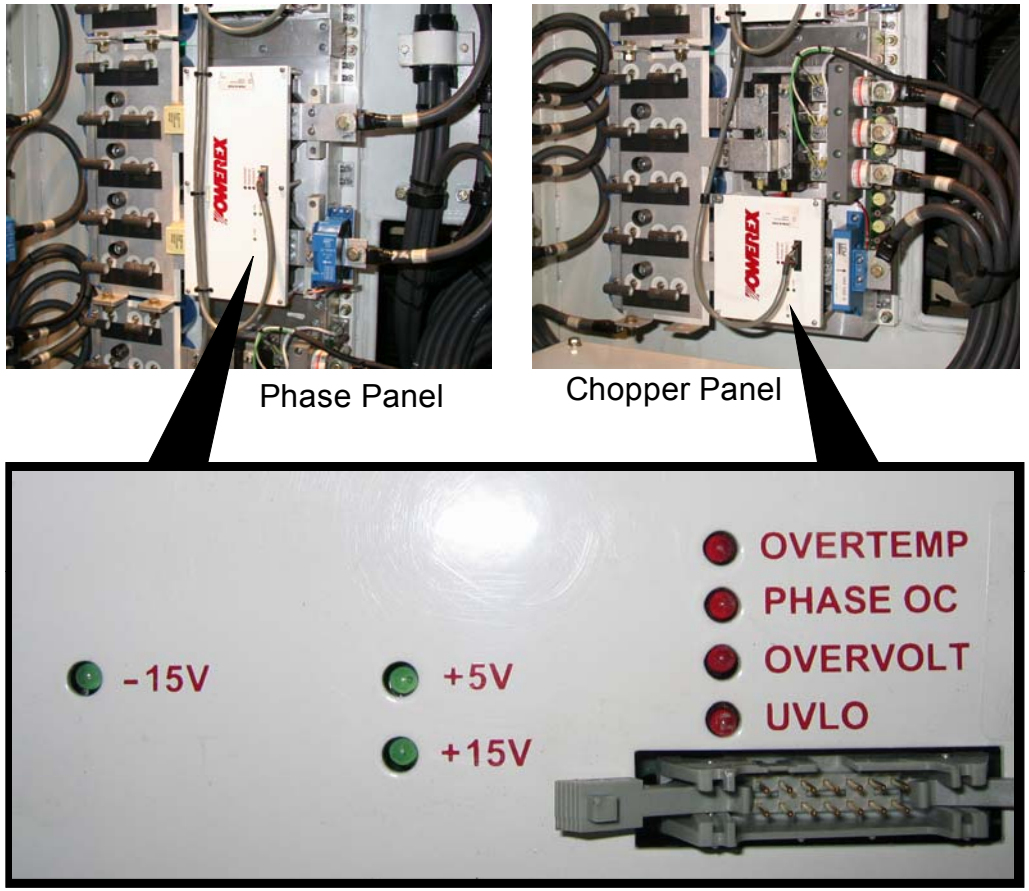
In a specific location - only the high side or only the low side switches are used as shown.





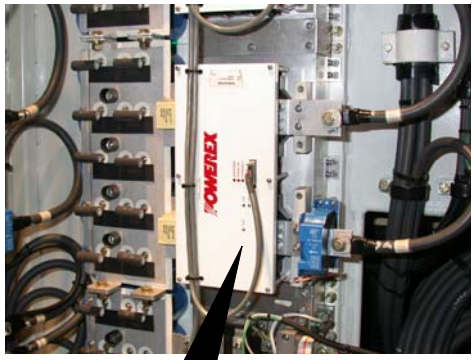


New Power Balance Resistors (SIL 411 and 419)

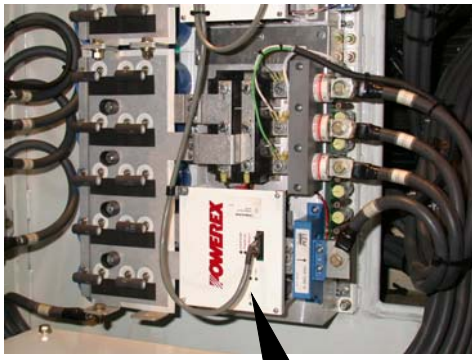


Green
(On all the time when system is powered)
-15V
+15V
+5V

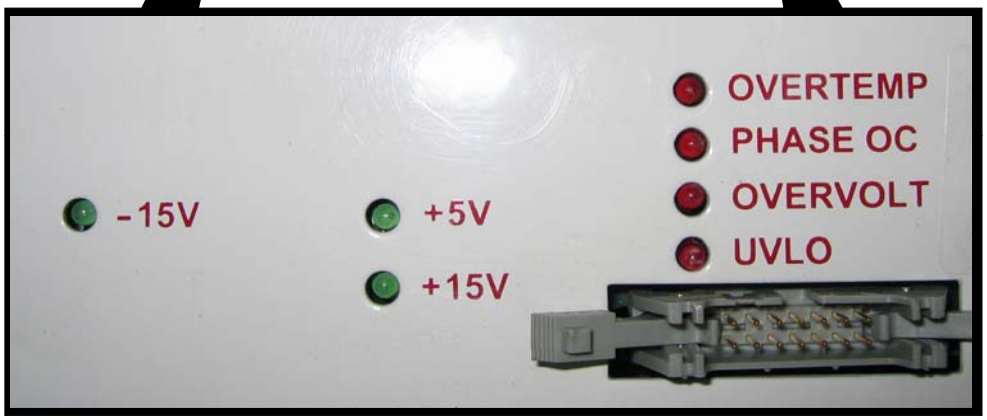
IGBT Indicator Lights



Phase Panel



Chopper Panel

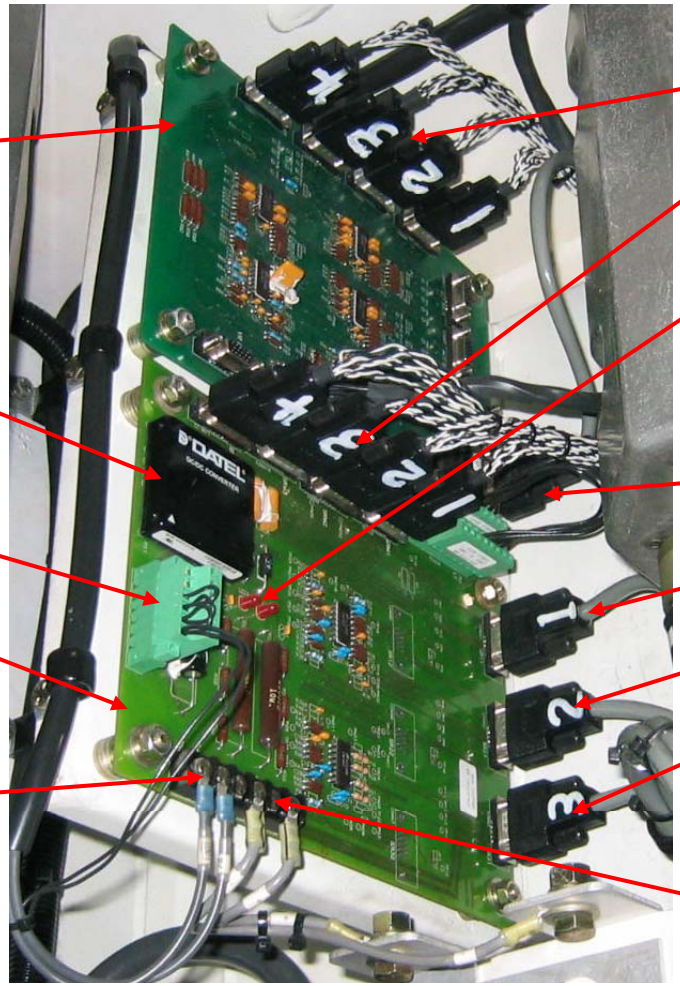


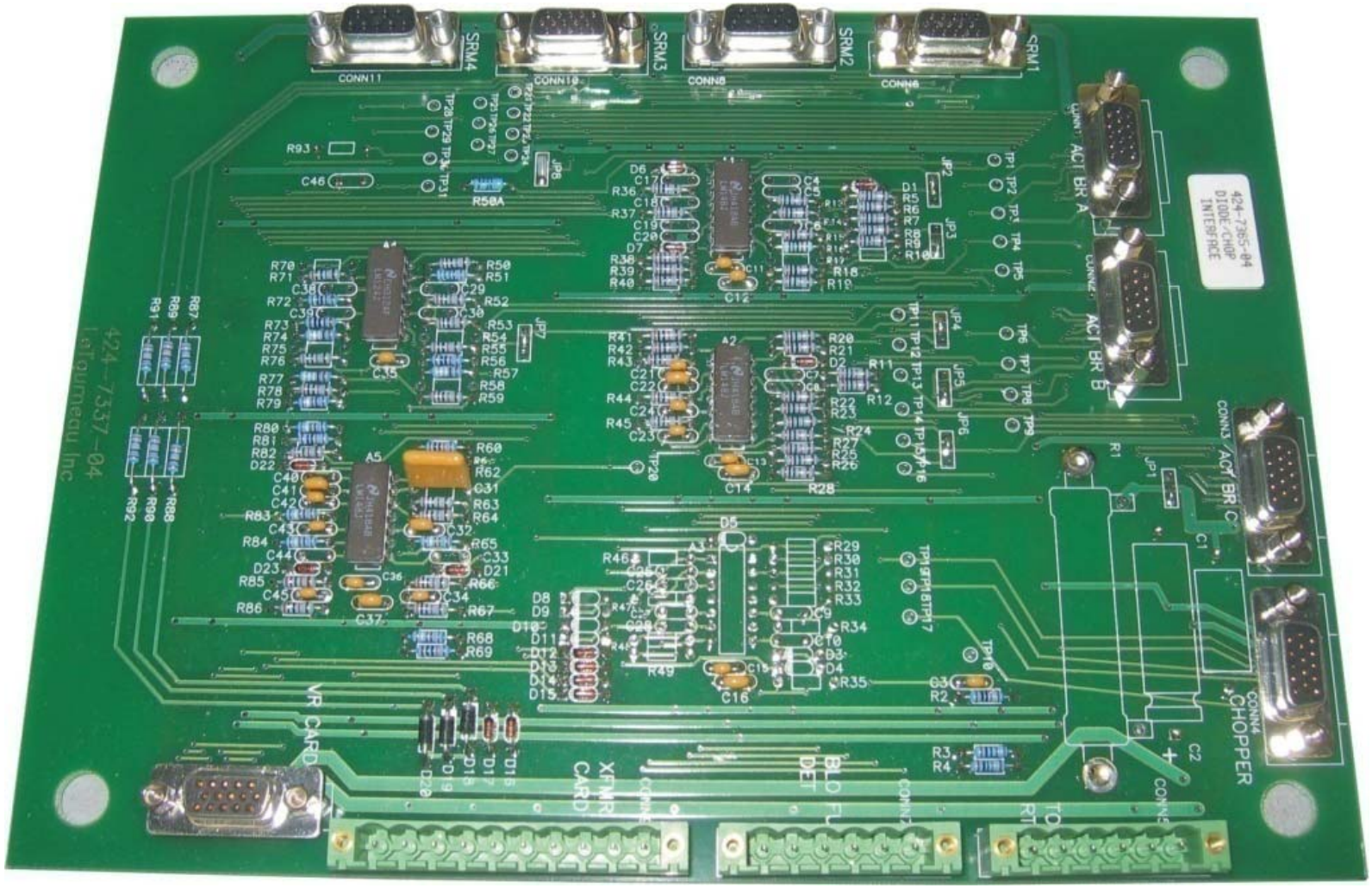
Red

(Off at all times unless there is a failure)
OVERTEMP - on when temperature over 98°Con heatsink is measured
PHASE OC - on when current over 1500A is measured
OVERVOLT - on when voltage over 920V is measured
UVLO - on when Supply voltage (24vdc) drops

IGBT Indicator Lights

Interface Cards

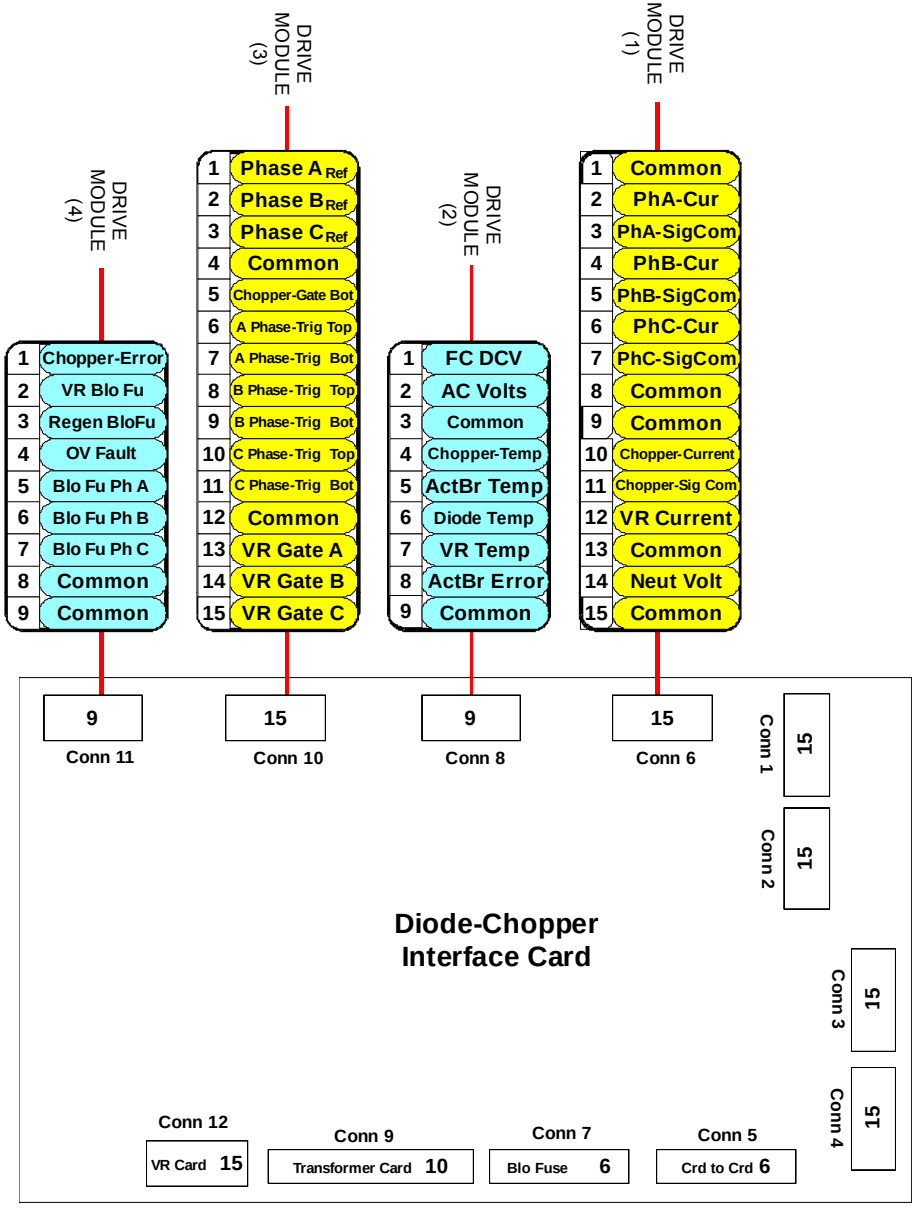




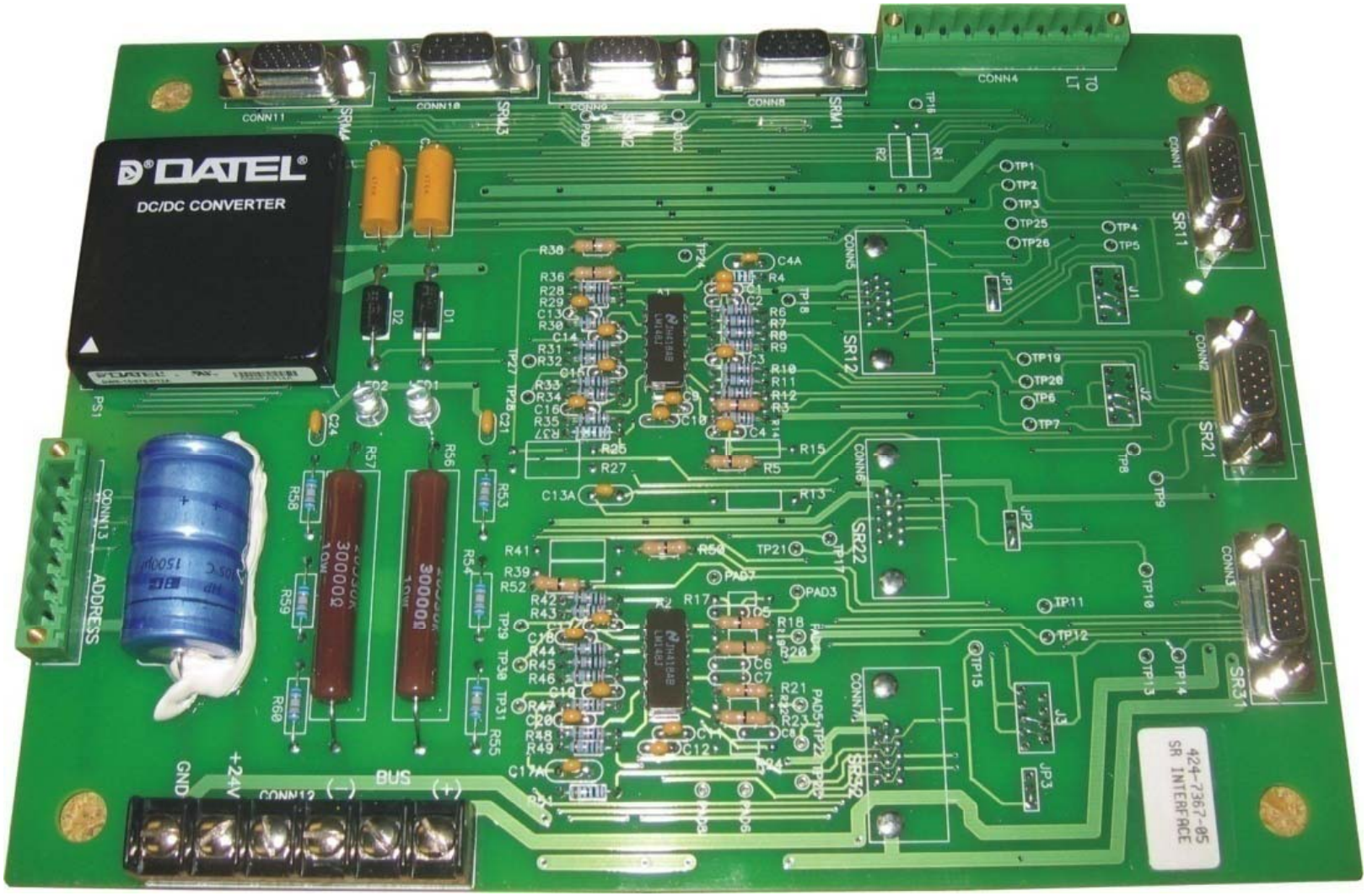
Diode ChopperCard

Component Descriptions

LeTourneau Technologies, Inc.


DRIVE MODULE (4)
1 Chopper-Error
2 VR Blo Fu
3 Regen BloFu
4 OV Fault
5 Blo Fu Ph A
6 Blo Fu Ph B
7 Blo Fu Ph C
8 Common
9 Common
DRIVE MODULE (3)
1 Phase A Ref
2 Phase B Ref
3 Phase C Ref
4 Common
5 Chopper-Gate Bot
6 A Phase-Trig Top
7 A Phase-Trig Bot
8 B Phase-Trig Top
9 B Phase-Trig Bot
10 C Phase-Trig Top
11 C Phase-Trig Bot
12 Common
13 VR Gate A
14 VR Gate B
15 VR Gate C
DRIVE MODULE (2)
1 FC DCV
2 AC Volts
3 Common
4 Chopper-Temp
5 ActBr Temp
6 Diode Temp
7 VR Temp
8 ActBr Error
9 Common
DRIVE MODULE (1)
1 Common
2 PhA-Cur
3 PhA-SigCom
4 PhB-Cur
5 PhB-SigCom
6 PhC-Cur
7 PhC-SigCom
8 Common
9 Common
10 Chopper-Current
11 Chopper-Sig Com
12 VR Current
13 Common
14 Neut Volt
15 Common
9 Conn 11
15 Conn 10
9 Conn 8
15 Conn 6
Conn 1 15
Conn 2 15
Diode-Chopper Interface Card
Conn 3 15
Conn 4 15
Conn 12 VR Card 15
Conn 9 Transformer Card 10
Conn 7 Blo Fuse 6
Conn 5 Crd to Crd 6

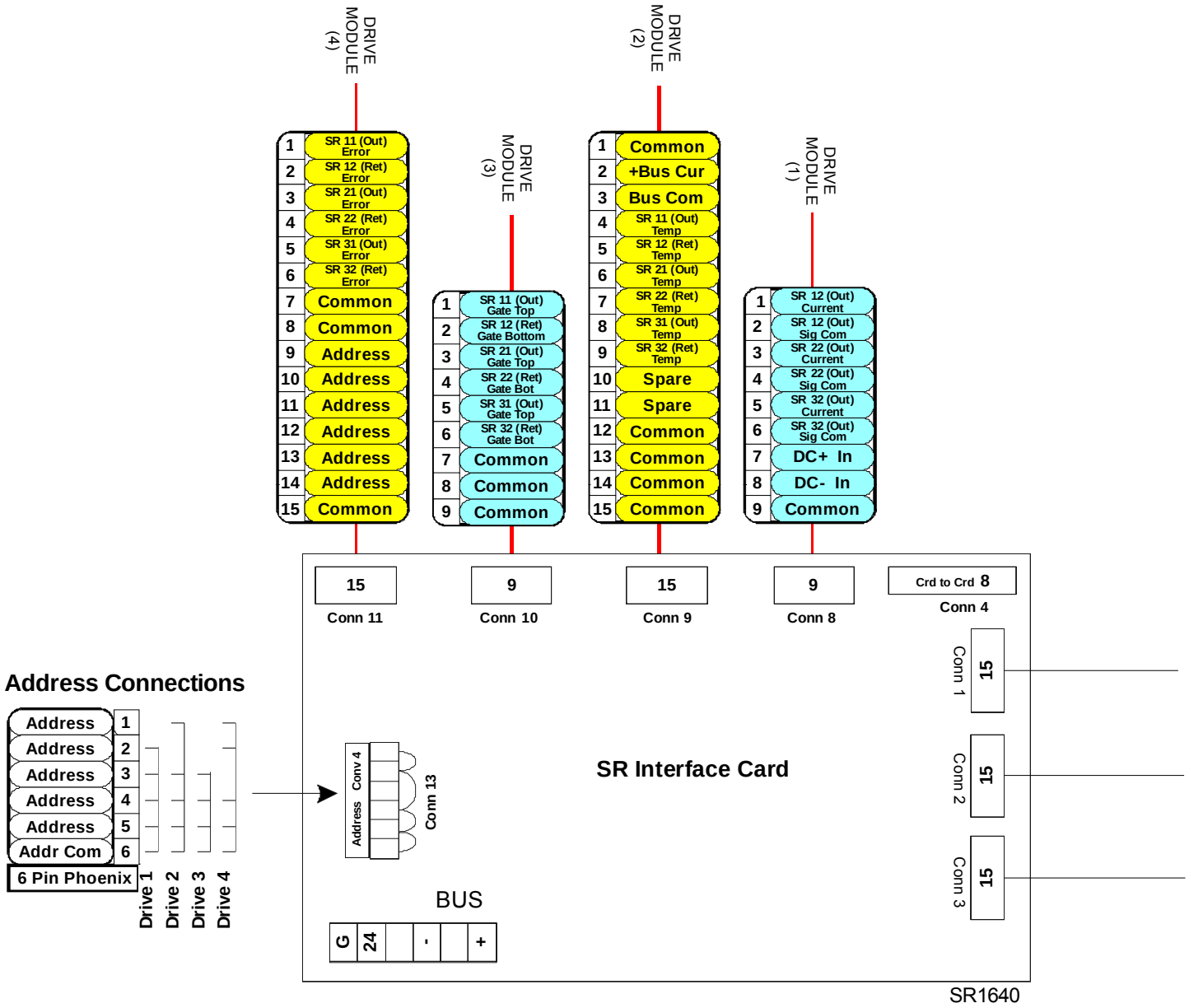
SR1639



SR Interface Card

Component Descriptions

LeTourneau Technologies, Inc.

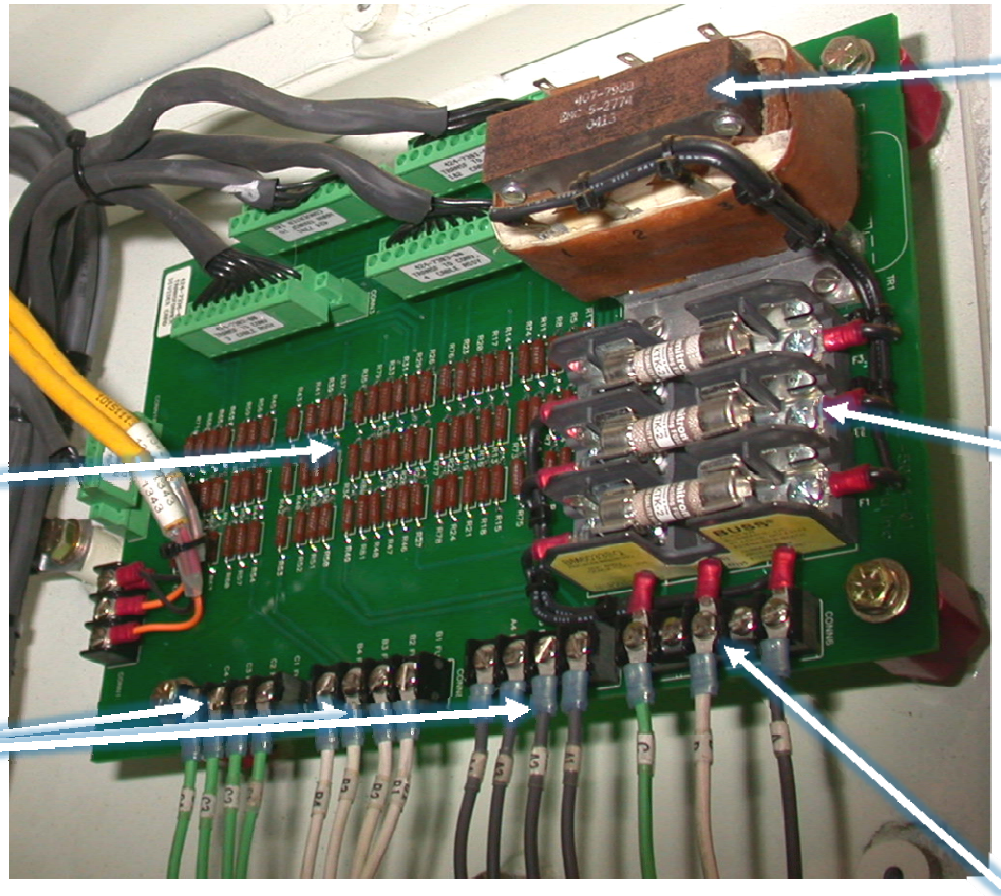


Component Descriptions

LeTourneau Technologies, Inc.

Transformer / Blown Fuse Detect Card

Compares AC supply to voltage at package which is fused. If there is a voltage difference a blown fuse is detected.



407-7988 6 phase transformer
Phase to common (0) on output approx. 25 ohms
Phase to phase on output approx. 50 ohms
Phase to phase on input approx 700 ohms

Output approximately: 30VAC Phase to Common
50VAC Phase to Phase

INPUTS

TO DIODE CHOPPER INTERFACE CARD #1

COMMON CONN5 1
PHASE AT CONN5 2
PHASE BT CONN5 3
PHASE CT CONN5 4

A PH FUSE CONN1 1
A PH REF CONN1 2
B PH FUSE CONN1 3
B PH REF CONN1 4
C PH FUSE CONN1 5
C PH REF CONN1 6
COMMON CONN1 7
PHASE AT CONN1 8
PHASE BT CONN1 9
PHASE CT CONN1 10

TO DIODE CHOPPER INTERFACE CARD #2

A PH FUSE CONN2 1
A PH REF CONN2 2
B PH FUSE CONN2 3
B PH REF CONN2 4
C PH FUSE CONN2 5
C PH REF CONN2 6
COMMON CONN2 7
PHASE AT CONN2 8
PHASE BT CONN2 9
PHASE CT CONN2 10

TO DIODE CHOPPER INTERFACE CARD #3

A PH FUSE CONN3 1
A PH RE CONN3 2
B PH FUSE CONN3 3
B PH RE CONN3 4
C PH FUSE CONN3 5
C PH REF CONN3 6
COMMON CONN3 7
PHASE AT CONN3 8
PHASE BT CONN3 9
PHASE CT CONN3 10

TO DIODE CHOPPER INTERFACE CARD #4

A PH FUSE CONN4 1
A PH REF CONN4 2
B PH FUSE CONN4 3
B PH REF CONN4 4
C PH FUSE CONN4 5
C PH REF CONN4 6
COMMON CONN4 7
PHASE AT CONN4 8
PHASE BT CONN4 9
PHASE CT CONN4 10

R74 R73 R75
R1 R2 R3
R5 R4 R6
R8 R7 R9
R11 R10 R12
R76 R77 R78
R14 R13 R15
R17 R16 R18
R20 R19 R21
R23 R22 R24
R79 R80 R81
R26 R25 R27
R29 R28 R46
R31 R30 R47
R33 R32 R48

8 NC 5 0
7 1 3
9 6 4 NC NC
2

F1
F2
F3

CONN6 1 A
NC CONN6 2 NOT USED
CONN6 3 B
NC CONN6 4 NOT USED
CONN6 5 C

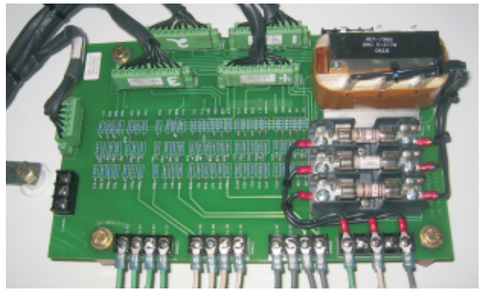
From Fuses on Diode Bridge for each Motor

R35 R34 R49 CONN7 1 A1 PH FU
R37 R36 R50 CONN7 2 A2 PH FU
R39 R38 R51 CONN7 3 A3 PH FU
R41 R40 R52 CONN7 4 A4 PH FU
R43 R42 R53 CONN8 1 B1 PH FU
R45 R44 R54 CONN8 2 B2 PH FU
R56 R55 R57 CONN8 3 B3 PH FU
R59 R58 R60 CONN8 4 B4 PH FU
R62 R61 R63 CONN9 1 C1 PH FU
R65 R64 R66 CONN9 2 C2 PH FU
R68 R67 R69 CONN9 3 C3 PH FU
R71 R70 R72 CONN9 4 C4 PH FU

CONN11 1 PRIME SW
CONN11 2 PRIME GATE
CONN11 3 COM

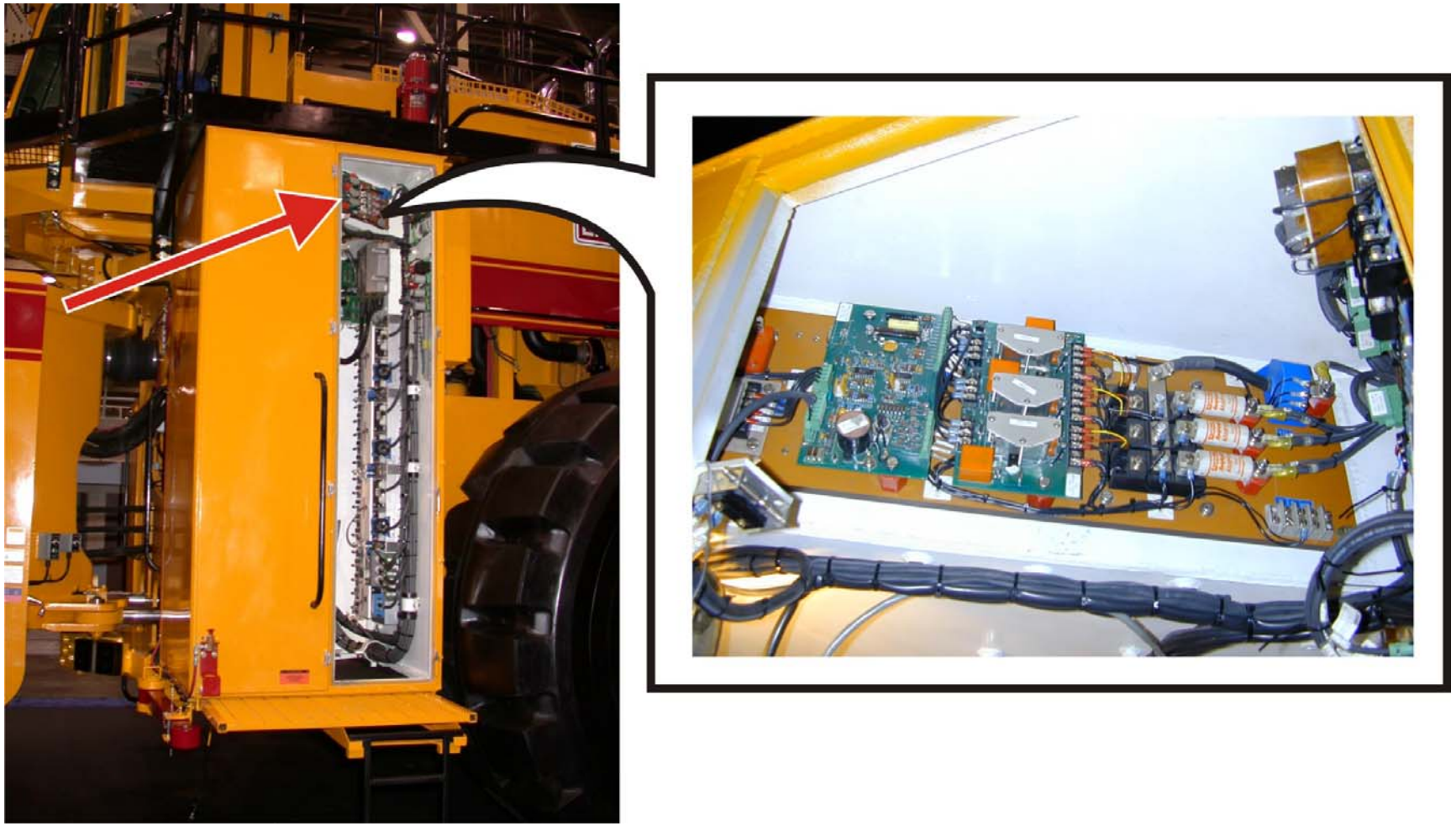
CONN10 1 A PH REF
CONN10 2 B PH REF
CONN10 3 C PH REF
CONN10 4 PRIME SW
CONN10 5 PRIME GATE
CONN10 6 COM

OUTPUTS



TRANSFORMER BOARD

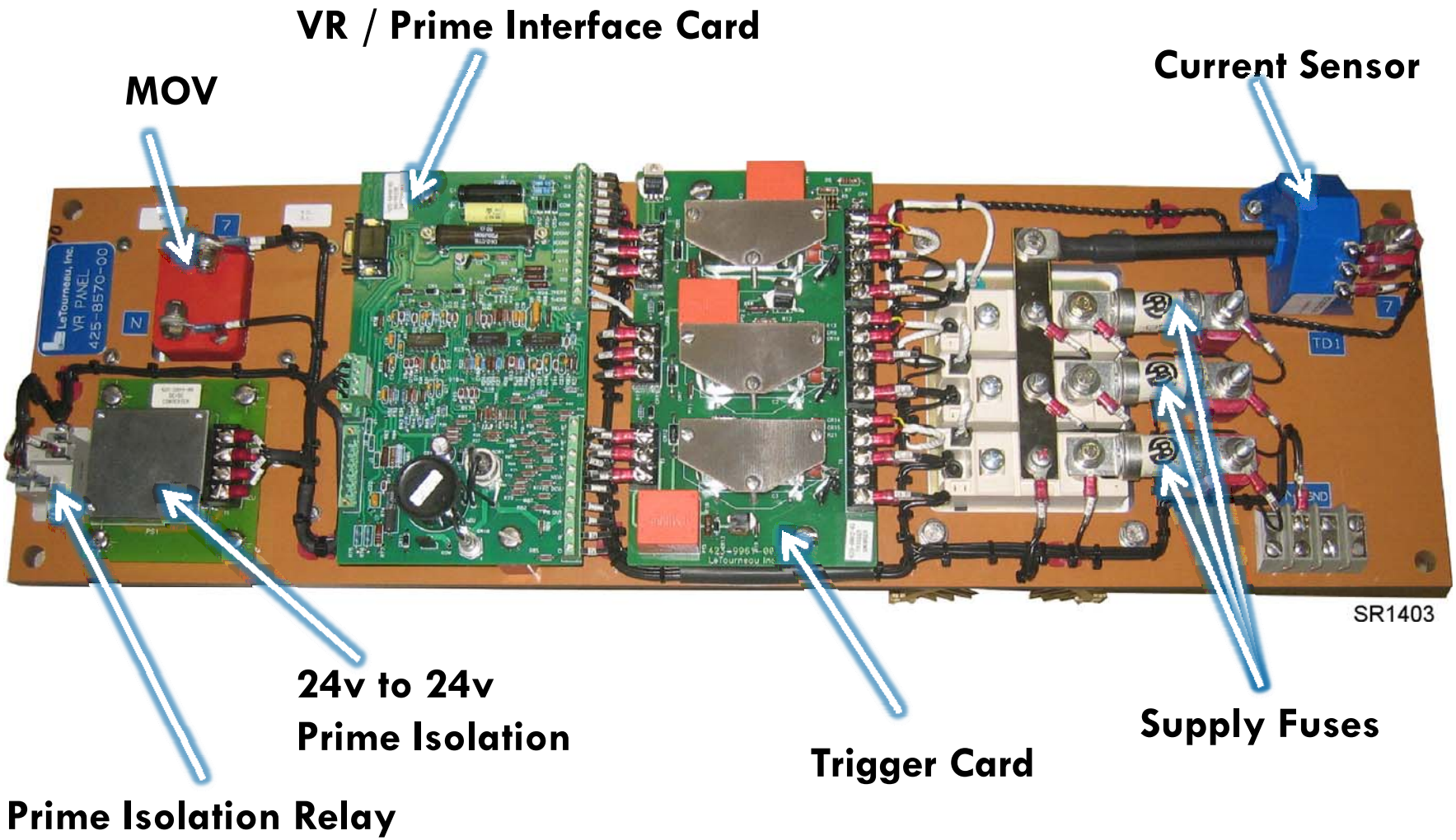
SR1665



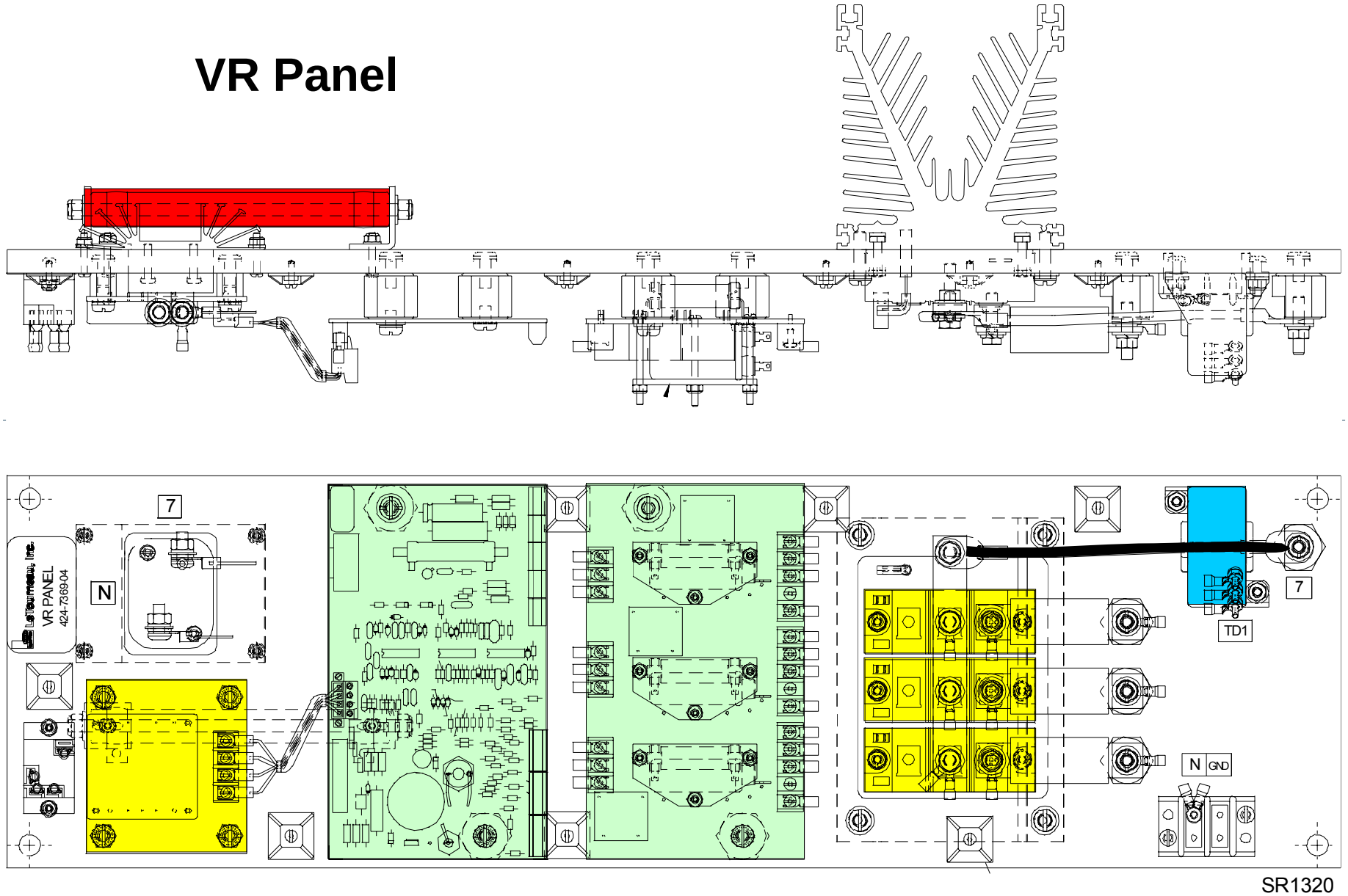
Voltage Regulator Panel

Component Descriptions

LeTourneau Technologies, Inc.


VR / Prime Interface Card
MOV
Current Sensor
SR1403
24v to 24v
Prime Isolation
Trigger Card
Supply Fuses
Prime Isolation Relay

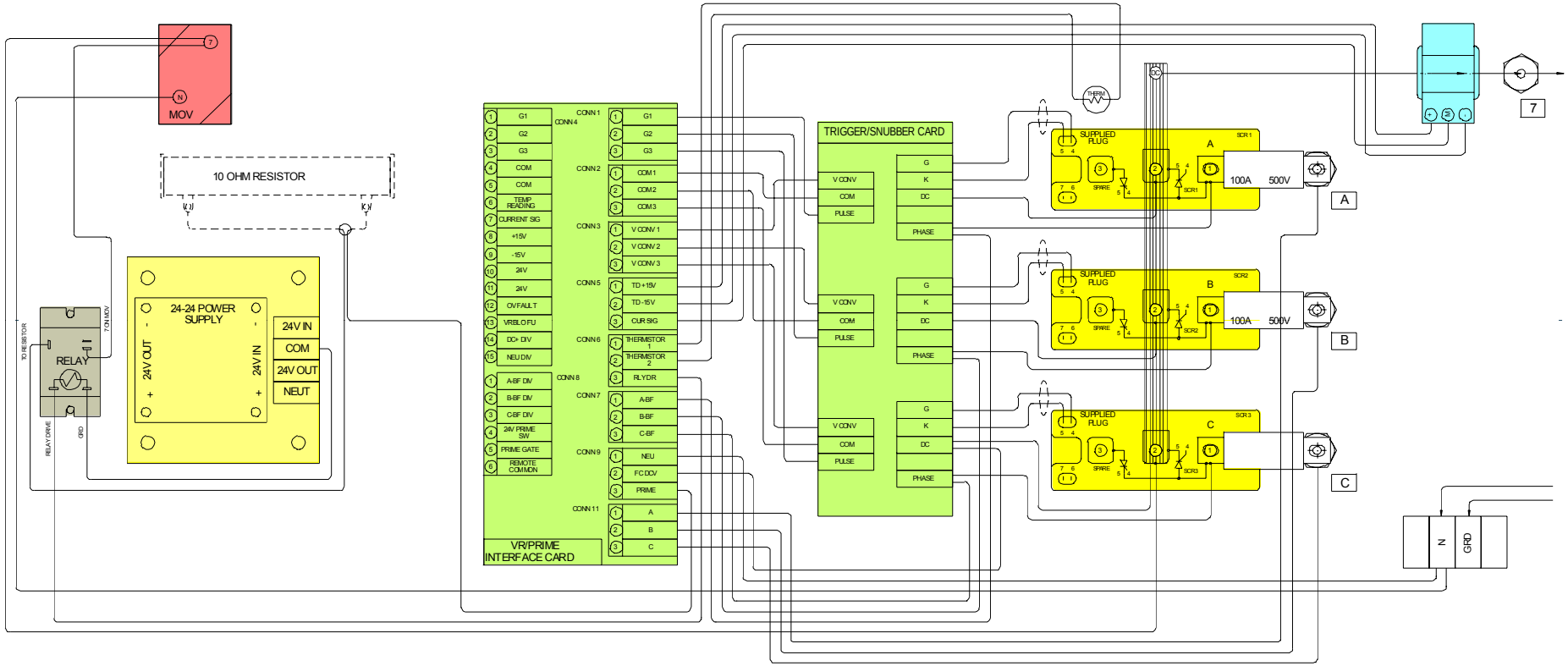
VR Panel



SR1320

Component Descriptions

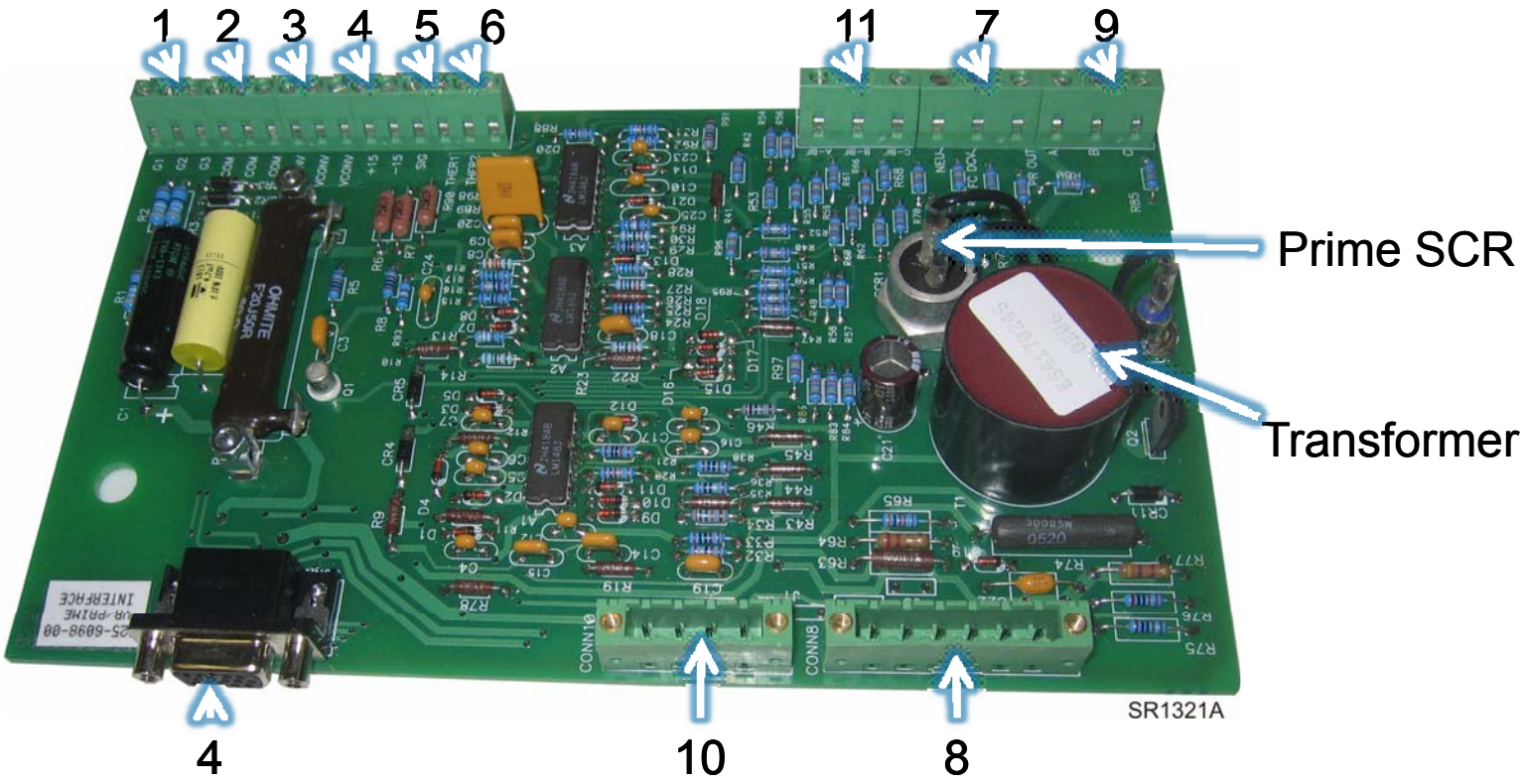
LeTourneau Technologies, Inc.



VR Panel Connections

Component Descriptions

LeTourneau Technologies, Inc.



VR Interface Card

Component Descriptions

LeTourneau Technologies, Inc.

NOTES:

GATE PULSE INPUTS (From Interface card and Drive Module)

GATE PULSEOUTNPUTS (to trigger card)

AC OVERVOLTAGE DETECTION CIRCUITS (HARDWARE 545 VAC)

GROUNDS THE GATE PULSES IN THE EVENT OF AN AC OVERVOLTAGE

24V

CONN4: G1, G2, G3, COM, COM, Temp'r Reading, Current Signal, +15V, -15V, 24V, 24V, OV Fault, VR Blown Fuse, DC+ DIV, NEU DIV

CONN1:A: G1, G2, G3

CONN2:A: COM, COM, COM

CONN3:A: VCONV, VCONV, VCONV

CONN5:A: TD +15V, TD −15V, CURRENT SIG

CONN6:A: R 1, R 2, E

CONN8:A: A, B, C, 24V PRIME SW, PRIME GATE, COM

CONN10: +24V, COM, 24−N, NEU

CONN11:1: A TAP, B TAP, C TAP

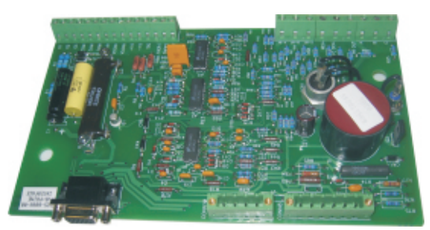
CONN7:1: A−BF TAP, B−BF TAP, C−BF TAP

CONN9:1: NEU, FC DCV, PRIME OUT

RELAY DRIVE

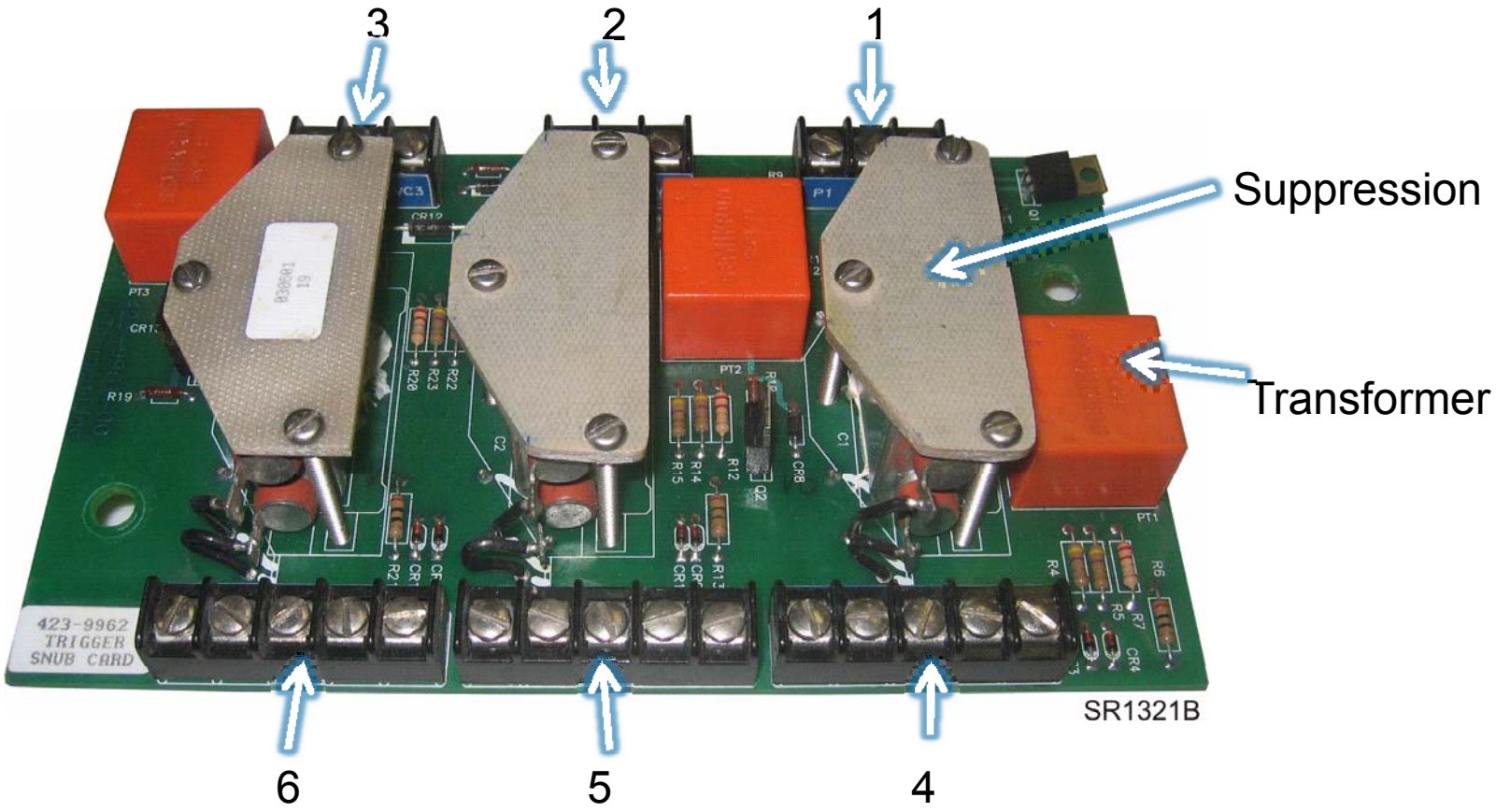
PRIME OUT

NEUTRAL



Schematic for VR Interface Card

SR1415



Trigger Card

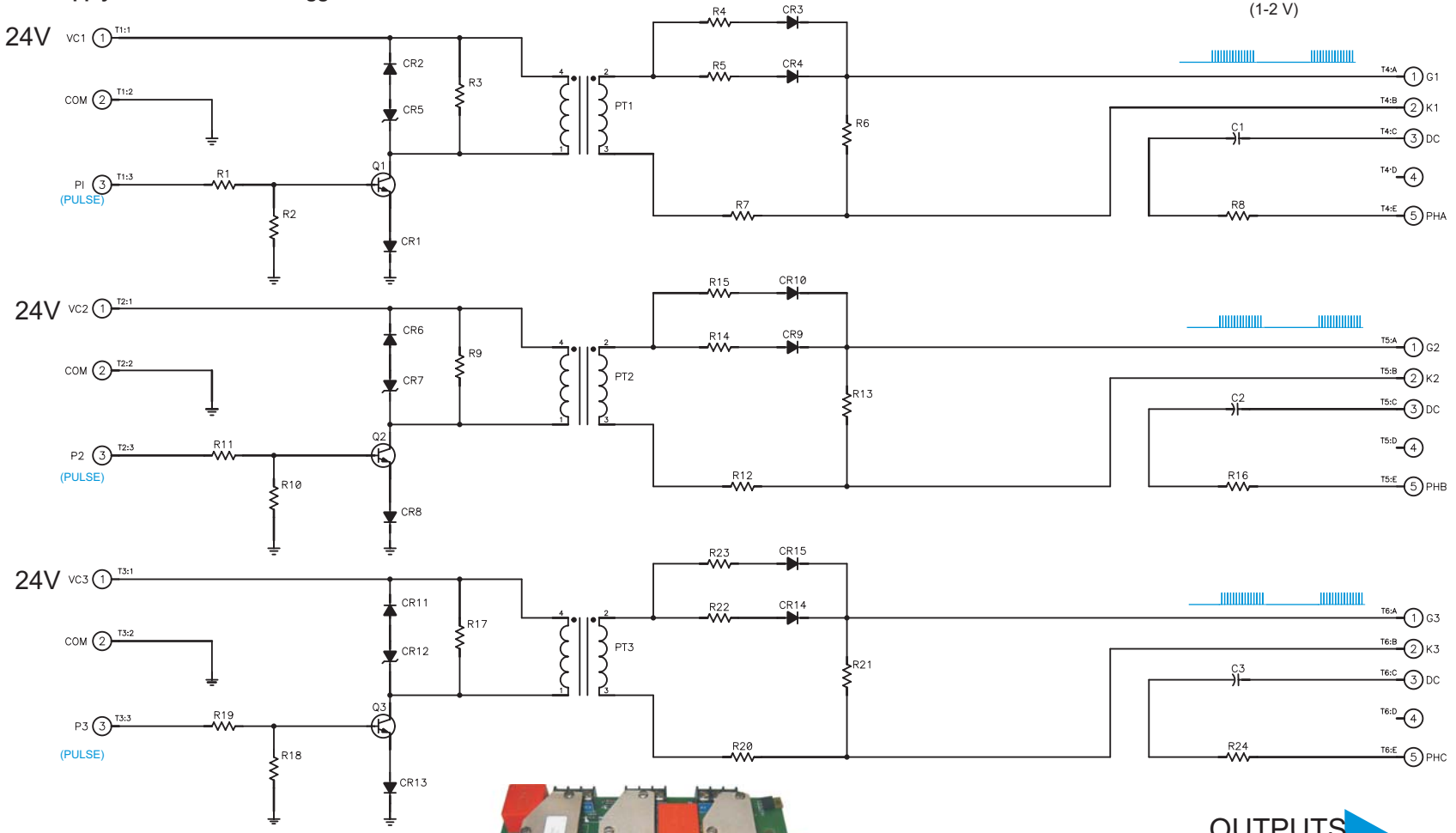
NOTE: 24V supply is used for the VR trigger circuits

GATE PULSES
FROM DRIVE MODULE
(0-15V)

G1

G2

G3



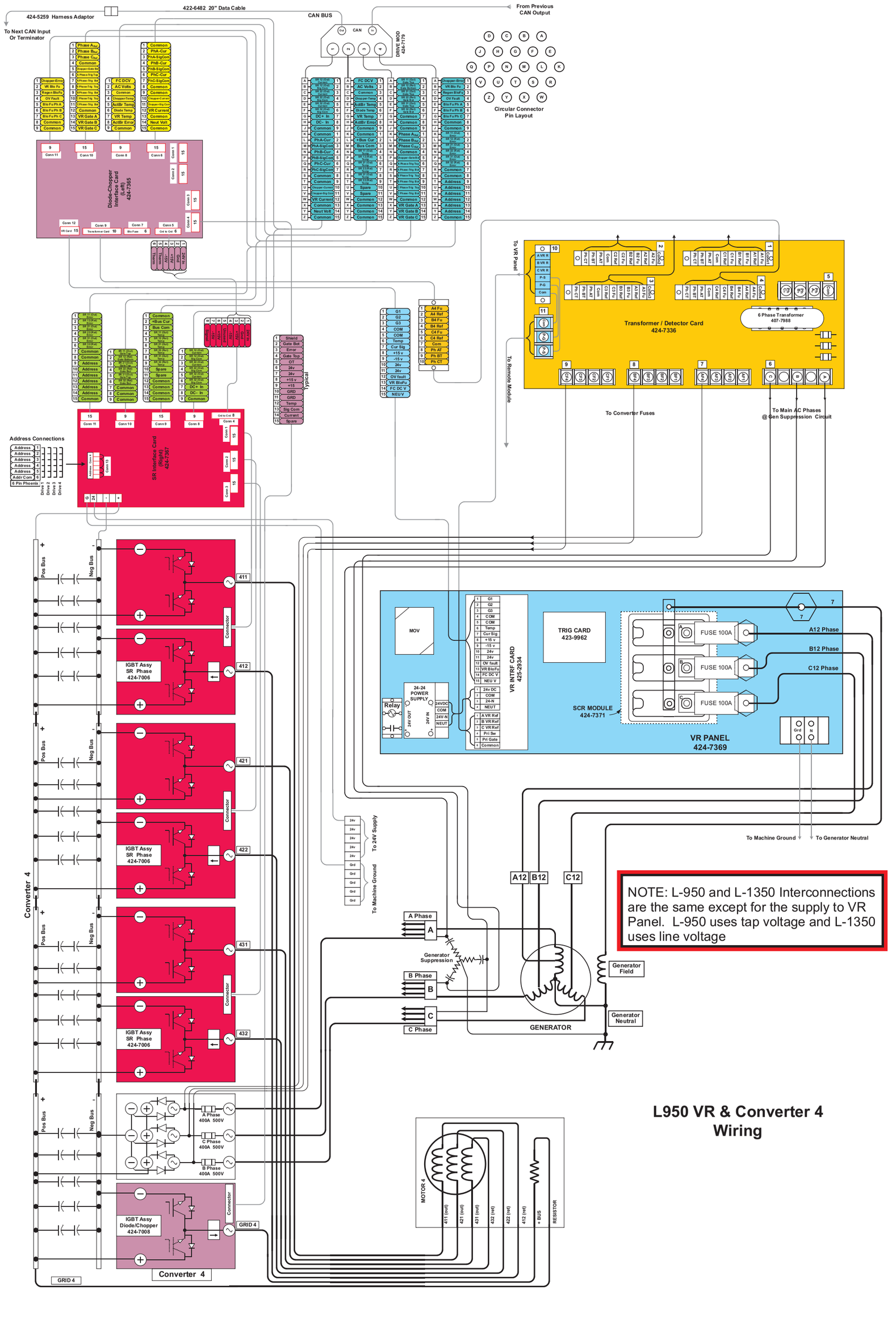
TRIGGER PULSES
TO SCR GATES
(1-2 V)

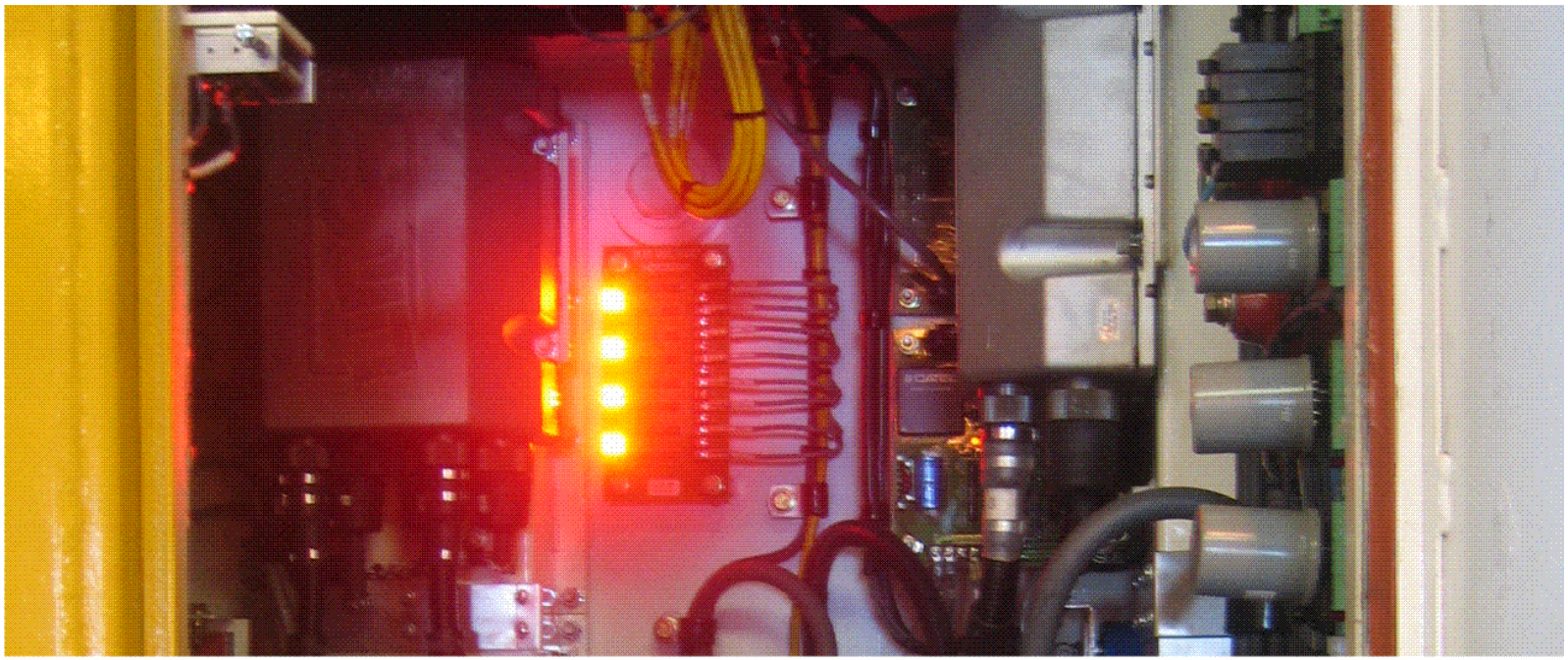
INPUTS

OUTPUTS

SR1666

TRIGGER CARD


424-5259 Harness Adaptor
422-6482 20" Data Cable
CAN BUS
From Previous CAN Output
To Next CAN Input Or Terminator
DRIVE MOD 424-7179
Circular Connector Pin Layout
Diode-Chopper Interface Card (Left) 424-7365
Transformer / Detector Card 424-7336
6 Phase Transformer 407-7988
To VR Panel
To Remote Module
To Converter Fuses
To Main AC Phases @ Gen Suppression Circuit
SR Interface Card (Right) 424-7367
Address Connections
Typical
MOV
TRIG CARD 423-9962
VR INTRF CARD 425-2934
24-24 POWER SUPPLY
Relay
SCR MODULE 424-7371
FUSE 100A
A12 Phase
B12 Phase
C12 Phase
VR PANEL 424-7369
To Machine Ground
To Generator Neutral
Converter 4
Pos Bus
Neg Bus
IGBT Assy SR Phase 424-7006
IGBT Assy Diode/Chopper 424-7008
Connector
411
412
421
422
431
432
GRID 4
A Phase 400A 500V
B Phase 400A 500V
C Phase 400A 500V
To 24V Supply
A Phase
B Phase
C Phase
Generator Suppression
Generator Field
Generator Neutral
GENERATOR
MOTOR 4
RESISTOR
NOTE: L-950 and L-1350 Interconnections are the same except for the supply to VR Panel. L-950 uses tap voltage and L-1350 uses line voltage
L950 VR & Converter 4 Wiring



SR1288

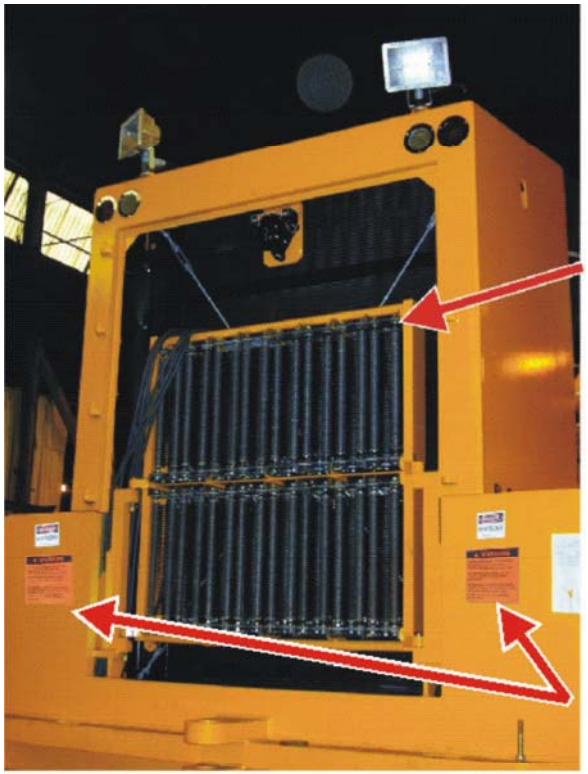
Buss Voltage Indicators

Component Descriptions

LeTourneau Technologies, Inc.

SR1109

L-950



SR1108

L-1350

Machine	Individual Grid resistance	Total grid resistance	Configuration	HP rating (continuous)
L-950/D-950	.596 Ω	2.38 Ω	4 in series	175HP
L-1350	1.21 Ω	1.82 Ω	6 in series/parallel	270 hp (GRADE CHART 207.5)

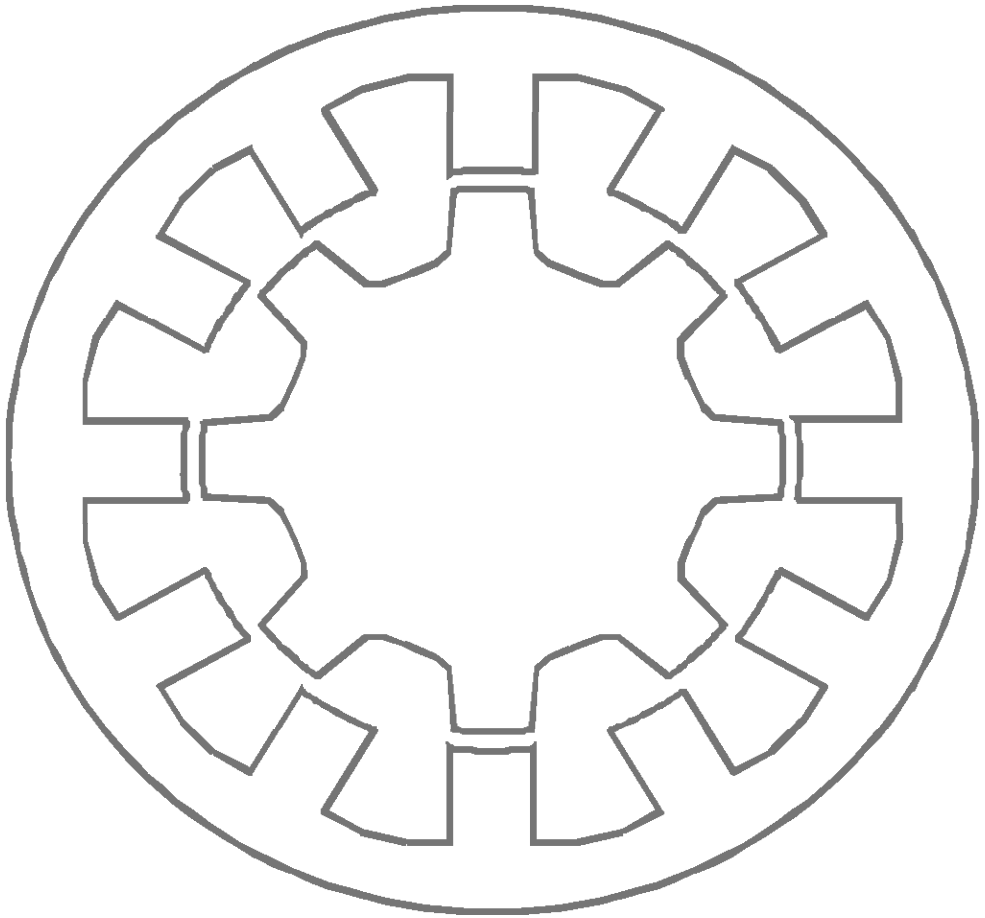
Braking Grids

Ground Fault Limiting Resistors

NOTES:

NOTES:

NOTES:

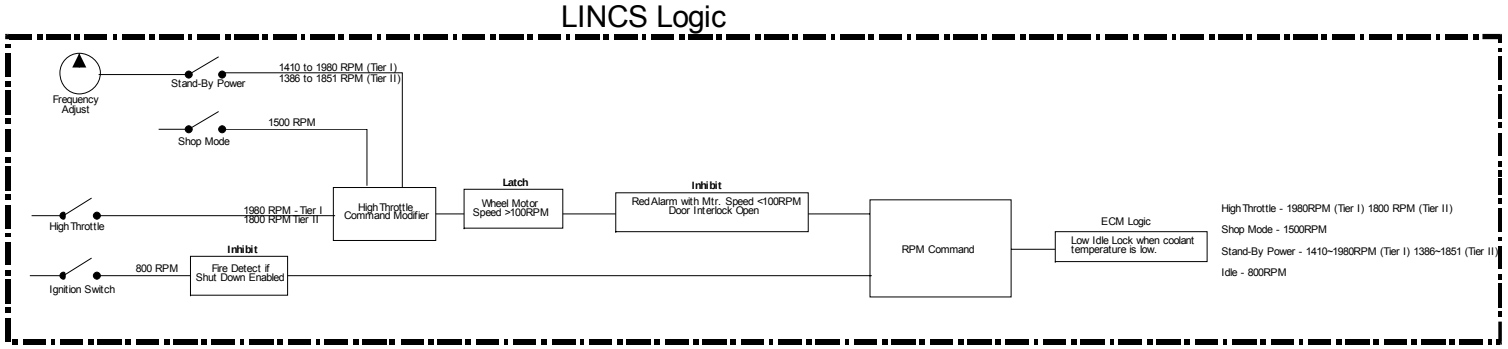


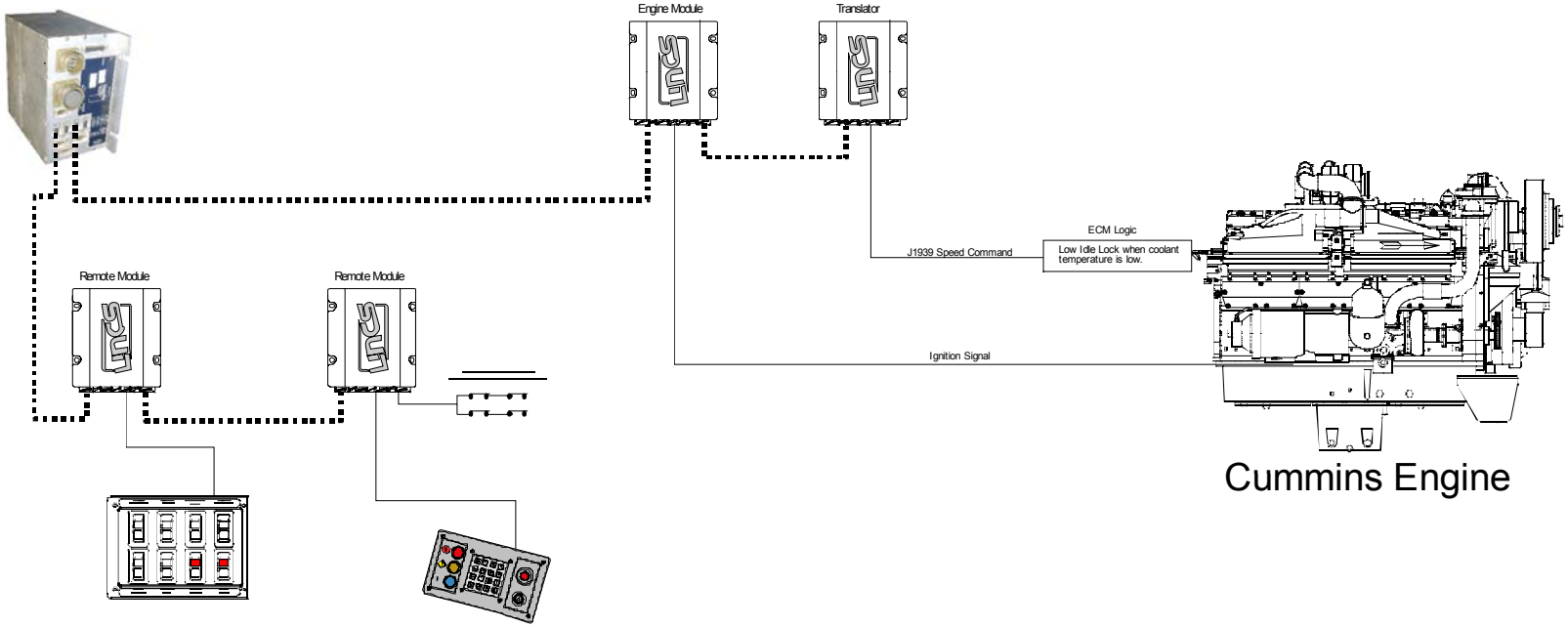
CIRCUIT DESCRIPTIONS

Theory of Operation

LeTourneau Technologies, Inc.

Engine RPM Command - Cummins

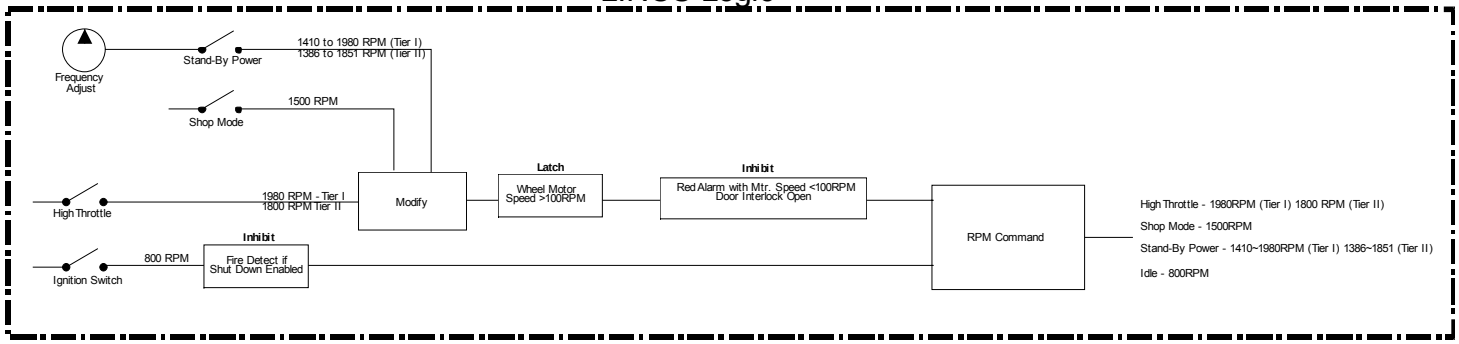


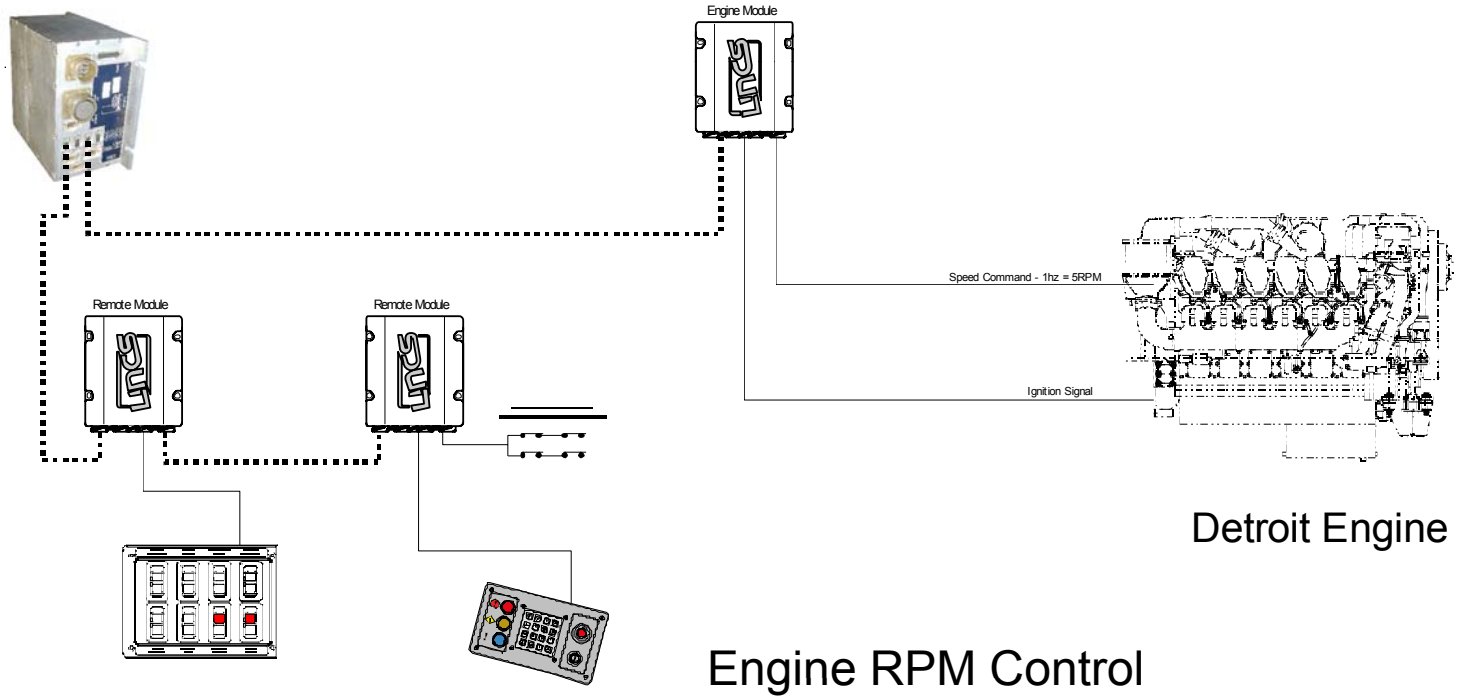


Engine RPM Control

Engine RPM Command - Detroit

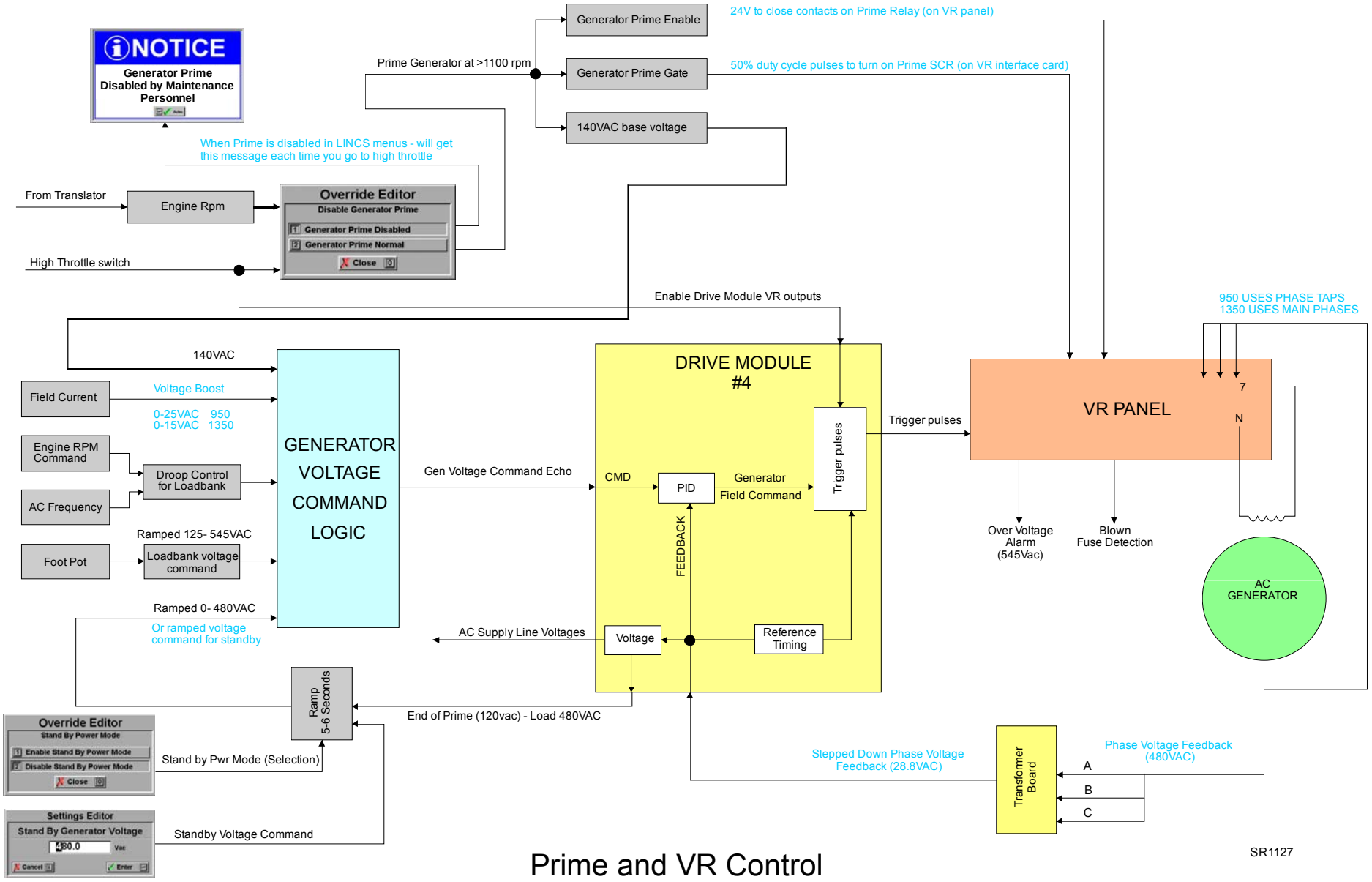
LINCS Logic



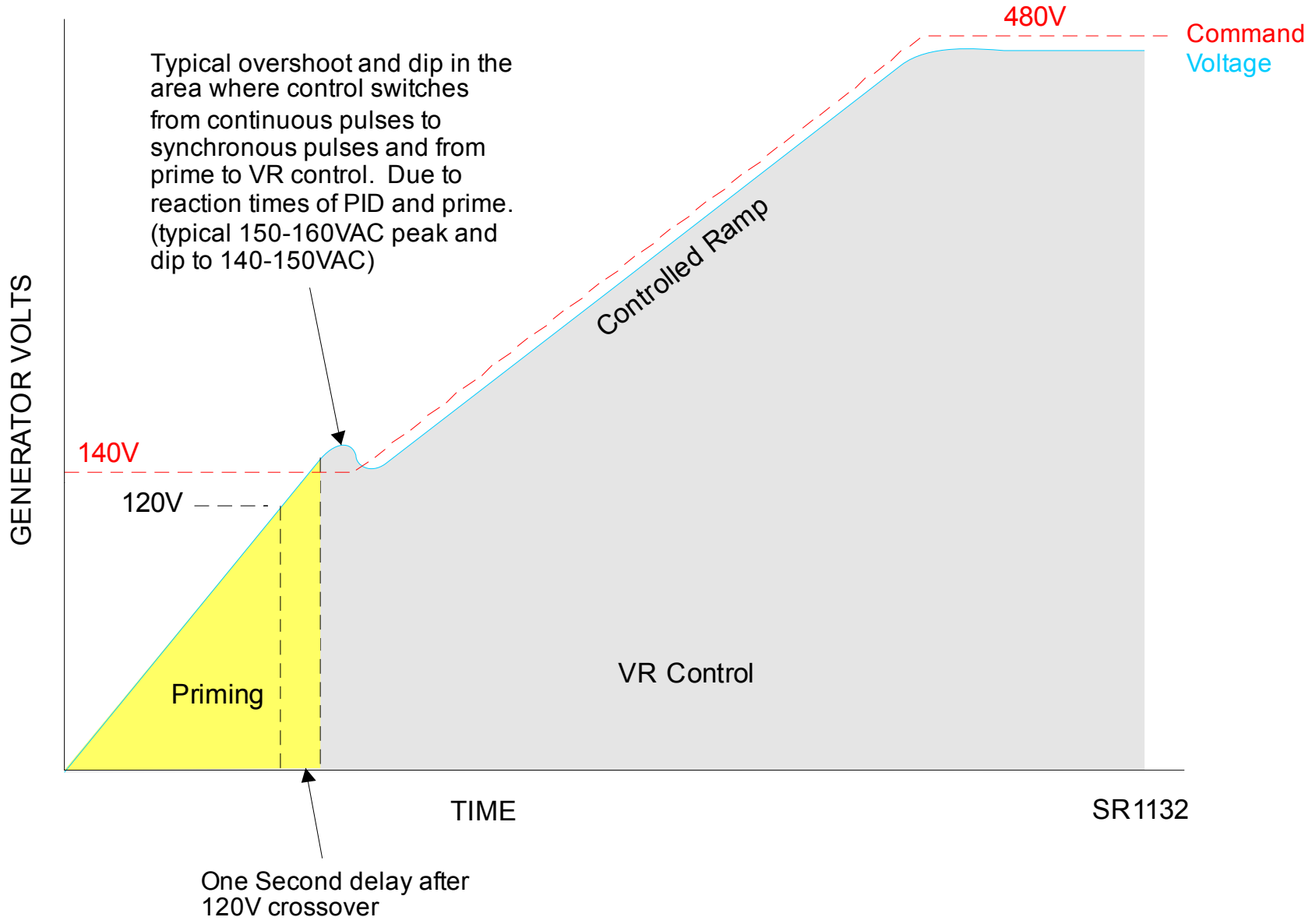


Detroit Engine

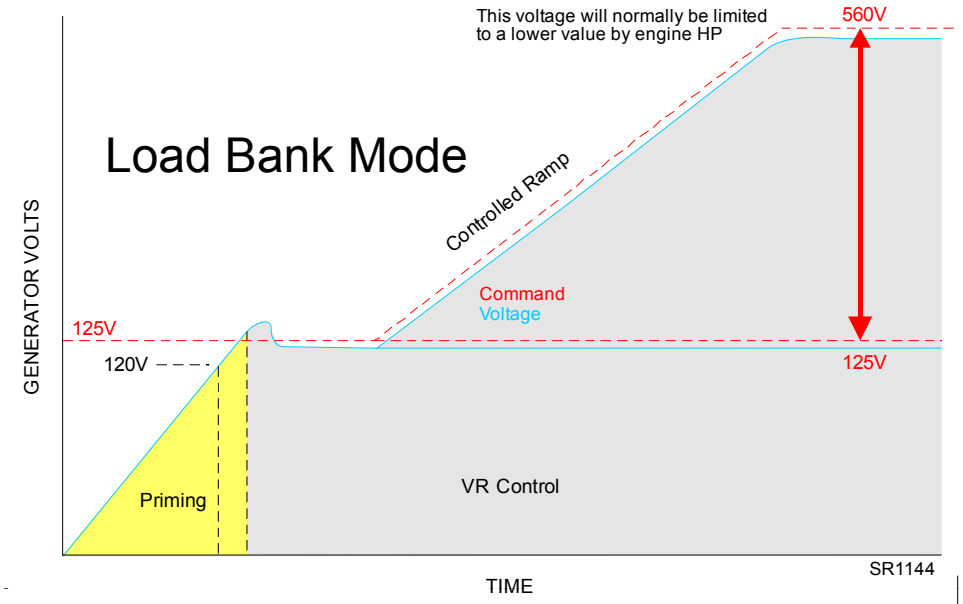
Engine RPM Control

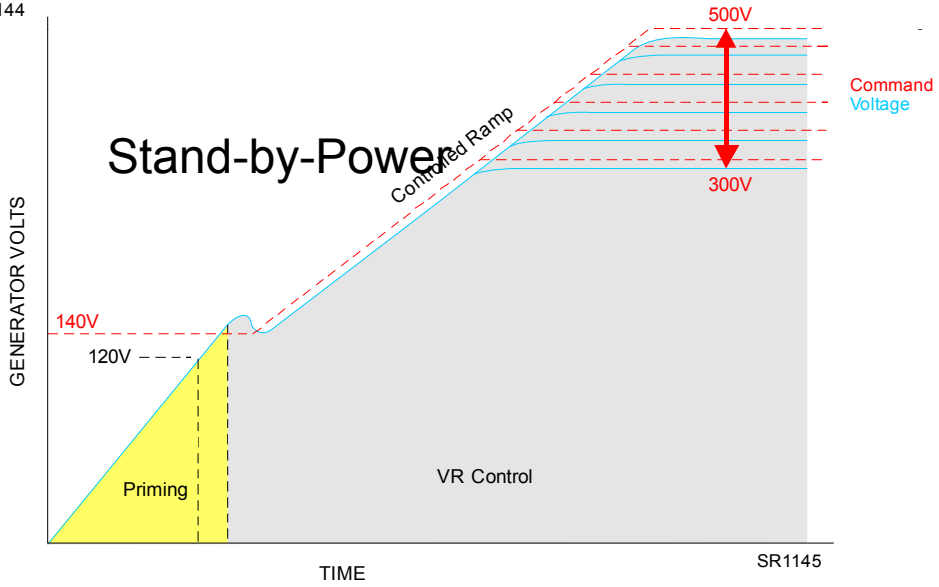


Prime and VR Control

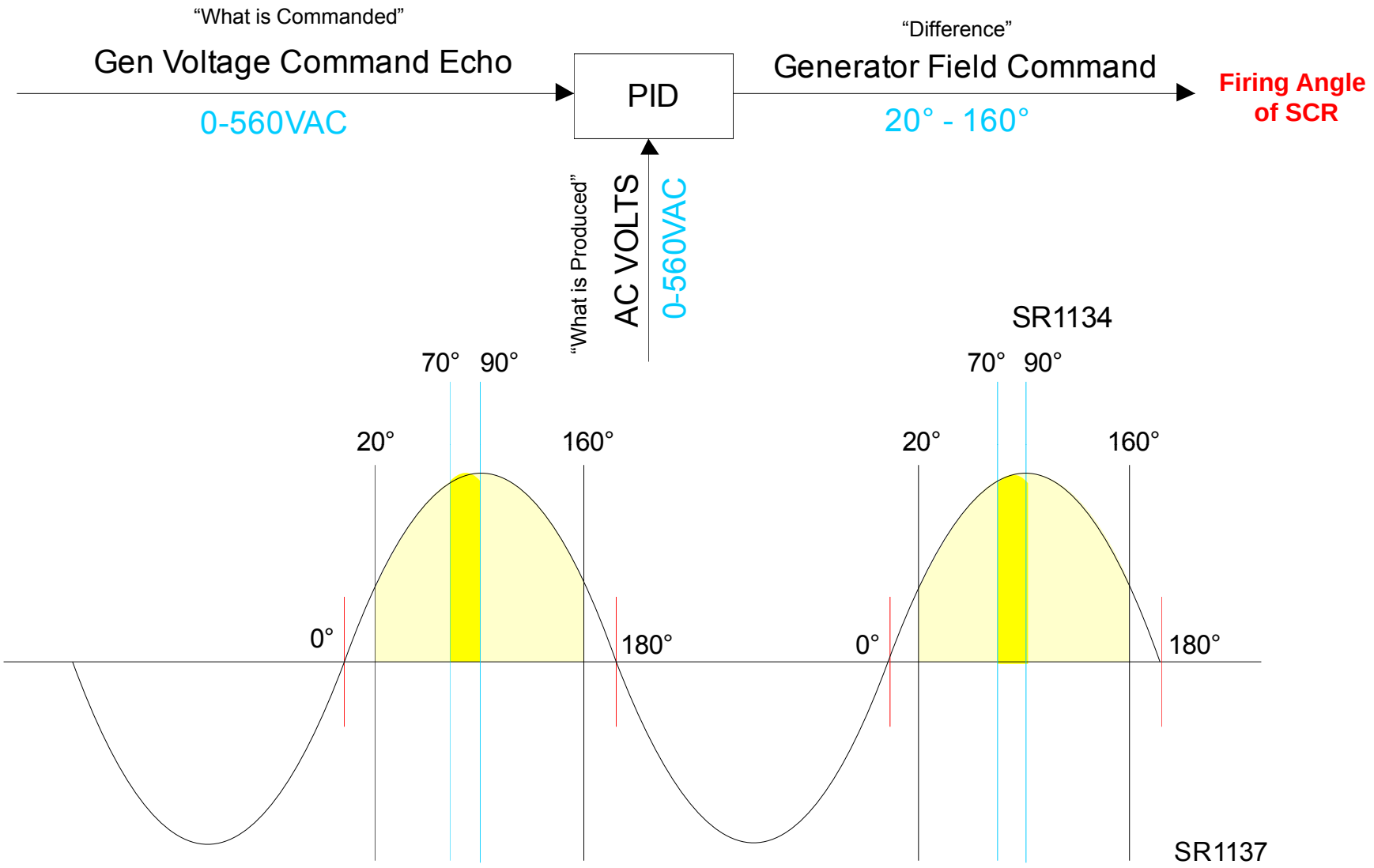


VR Control Normal Operation

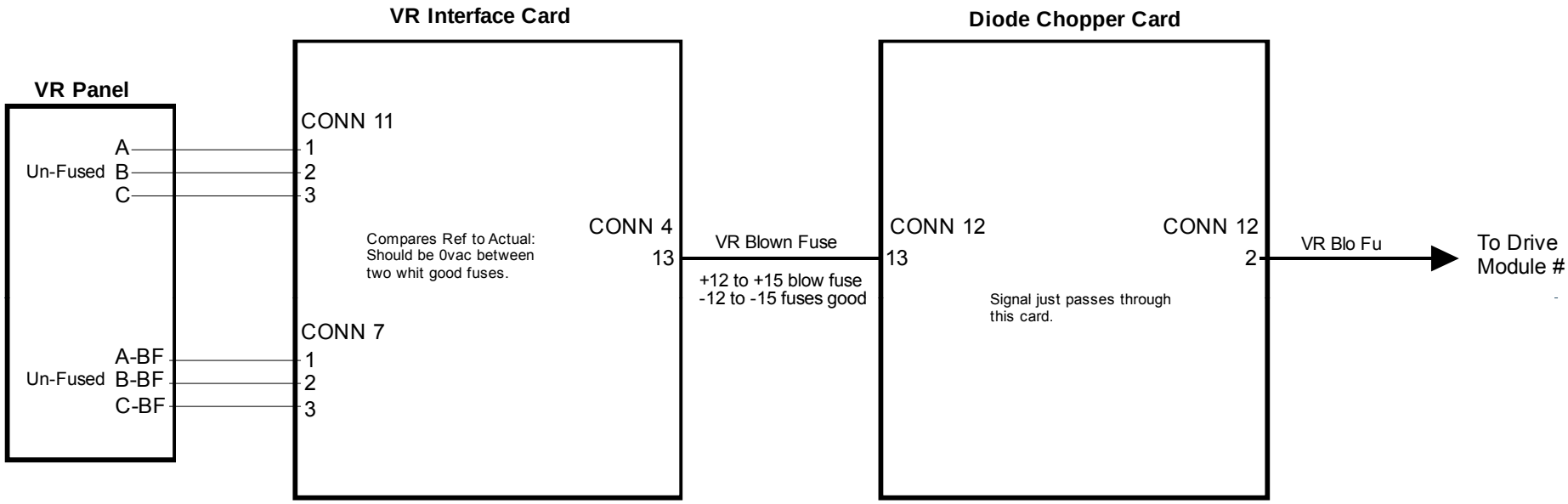




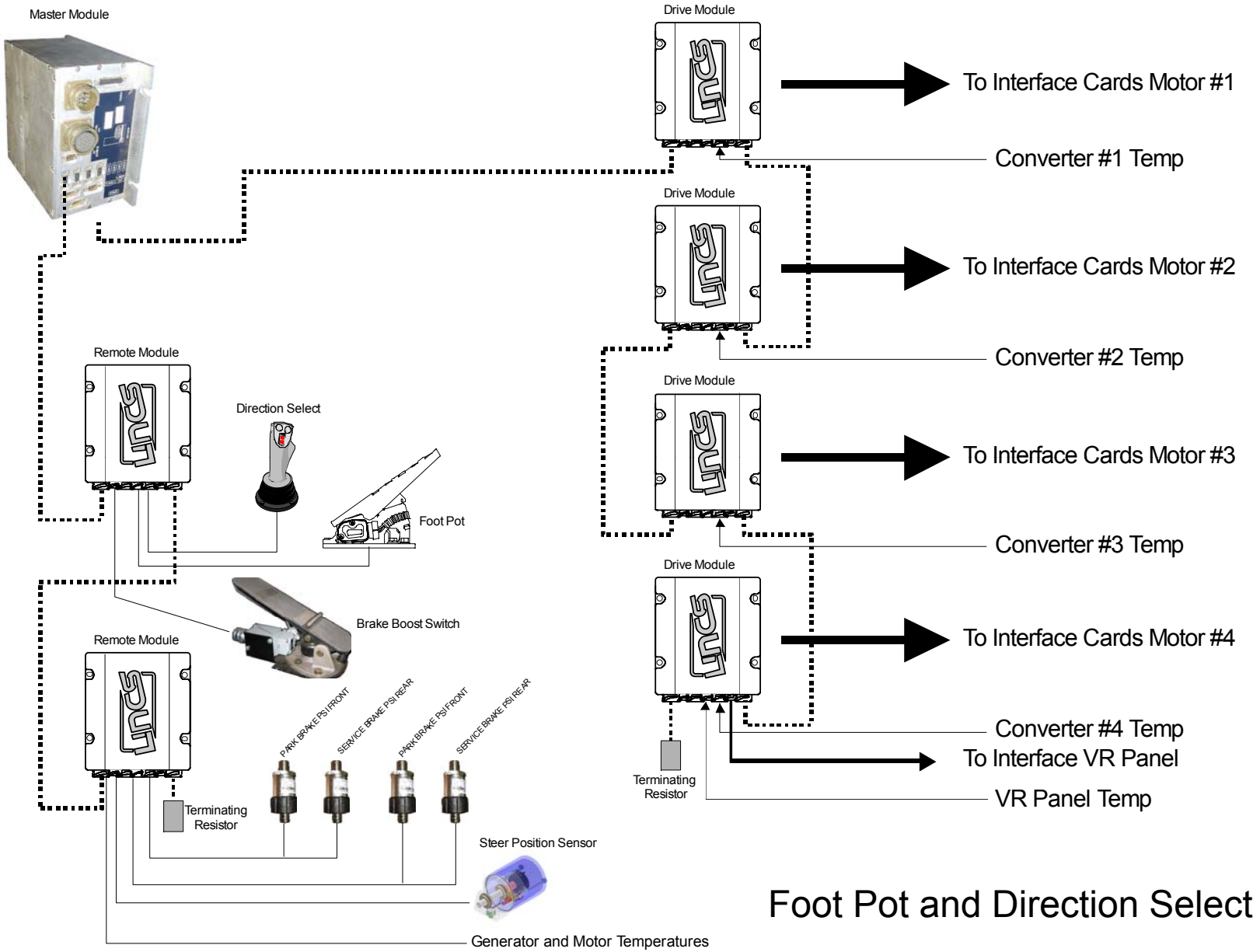
VR Control Special Modes



VR Panel SCR Firing Timing



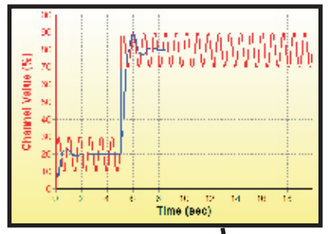
VR Blown Fuse Detection



Foot Pot and Direction Select

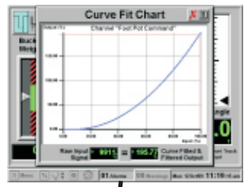
NOTES:

Foot Pot Logic Flow Chart



BS = Bandstop
Filters out oscillations in the 1 hz range and lets the rest through
Tire flex oscillation is in this frequency range.

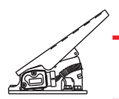
Converts 100% max command to 200%.
This give higher resolution of the command resulting in better over all control.



Filtering is not used when the foot pot full up or full down.

Wiper - The varying voltage changed by pedal position

Supply - The voltage supplied to the foot pot.
15vdc - resistive
5vdc hall effect



Select Foot Pot Type

1. Aluminum Resistive
2. Plastic Resistive
3. Hall Effect

Foot Pot Wiper

Foot Pot Supply

Ratio

Ratio between supply and wiper. Keeps changes in the supply voltage from effecting wiper signal.

Foot Pot Ratio

Calibration

Unique command for the installed foot pot. Since each foot pot is somewhat different due to manufacturing tollerences they must be calibrated. Full up to Full down.

0% (up)
100% (down)

Normalized Foot Pot

Filter

0% (up)
100% (down)

Filtered Foot Pot

Un-Filtered Foot Pot

Select

0% (up)
100% (down)

Final Foot Pot

Conversion

0-200%

Foot Pot Command

Foot Pot Cmd HillHold

> .01% Active Foot Pot
< .01% Inactive Foot Pot

Foot Pot must be seen as inactive to allow Hill Hold.

If in Neutral foot pot will always be seen as inactive.

Load Bank Generator Voltage

125VAC to 560VAC

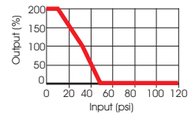
Used to increase generator voltage in Load Bank Mode proportional to how far the foot pot is applied.

Front Service Brake Pressure

Rear Service Brake Pressure

Select Largest

Starts to cutback at 10 psi
Fully cutback at 50 psi



Shop Mode

Reduces command by half if in Shop Mode

RED Alarms, Fire Detected, Load Bank Mode Active, Ladder Down, Park Brake set.

Reduces to 0% - full cutback

Notice Screen when:

Foot Pot >10% and generator is primed

Why No Propel Generator

Limits

0-200%

Limited Foot Pot

Direction Input

+ -

Direction Select

Fwd

Rev

Bipolar Footpot

Forward 0 to +200%
Reverse 0 to -200%
Neutral 0

Mod by Speed Limit

PID Loop

Speed Limit

Actual Machine Speed

Max Machine Speed

Alternate Machine Speed

Select Smallest

Selects between the normal top speed limit and the operator selected alternate machine speed limit.

Subtract

- = Reverse Torque
+ = Forward Torque

-100% to +100%

Torq Cmd Ramped

Brake Boost

Multiplies actual machine speed by 2

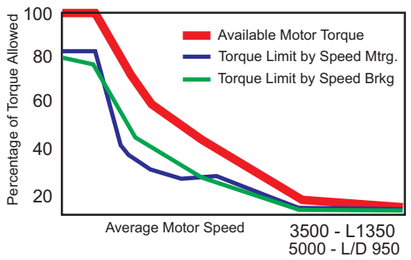
Red Alarm

Fire detected

Brake Boost Switch

LINCS Command Limit Logic

Inactive Foot Pot



Typical curves. Note that there are actually two curves - one for power and one for braking. Power curve to match the engine characteristics and braking curve to match the grids. Represents percentage of available that can be used.

Hill Hold is only active when the Foot Pot is released and the machine is not moving. Hill Hold will start out commanding 25% torque and adjust that percentage to the amount required to hold the machine stationary. If steering is active Hill Hold torque is held constant at the value at which steering began.

Steering not Active

Greatest Mtr Speed < 500rpm

Hill Hold

ABS BS Avg Motor Spd

0-100%

Curve

Torque Limit by Speed Mtrg

0-100%
Follows curve
Matched to engine HP

Curve

Torque Limit by Speed Brkg

0-100%
Follows curve
Matched to grid capability

Select

0-100%
Follows curve

Torque Limit by Speed Sel

Common Limits

Generator Temp >374f / 190c
VR Temp > 185f / 85c
Temps start out at 100% and reduce as temperature increase.

Front Limits

Torque Reduction via LINCS menu 40% to 100%

Rear Limits

Torque Reduction via LINCS menu 40% to 100%

Motor Temp >249f / 140c
Converter Temp > 185f / 85c
Temps start out at 100% and reduce as temperature increase.

- = Reverse Torque
+ = Forward Torque
-100% to +100%

Motor #1 Converter and Motor Temps → Motor Torque Limit #1

Motor #2 Converter and Motor Temps → Motor Torque Limit #2

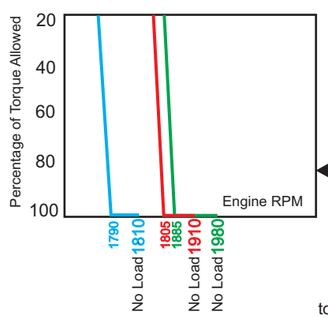
Motor #3 Converter and Motor Temps → Motor Torque Limit #3

Motor #4 Converter and Motor Temps → Motor Torque Limit #4

- = Reverse Torque
+ = Forward Torque
-100% to +100%

Torq Cmd Ramped

Select Smallest



Common Torque Limits

Engine Droop Control
Acceleration Limit
Brake Test (L-950 only)

Reduces allowable torque to 64% and overrides service brake reduction to allow machine to push against the applied brakes.

Slip Control compares average wheel speed to each individual motor. If motor speed exceeds the set allowable limit for difference (750 RPM) that motors torque is reduced. Braking torque can be applies to the motor if not steering and excessive slip is detected.

- = Reverse Torque
+ = Forward Torque
-100% to +100%

Steering Angle

Steering angle soften the allowable slip to account for articulation angle.

Motor #1 Slip Limit → Motor Torque CMD #1

Motor #2 Slip Limit → Motor Torque CMD #2

Motor #1 Slip Limit → Motor Torque CMD #3

Motor #2 Slip Limit → Motor Torque CMD #4

- = Reverse Torque
+ = Forward Torque
-100% to +100%

Motor Torque Limit #1

Motor Torque Limit #2

Motor Torque Limit #3

Motor Torque Limit #4

CAN BUS

Motor Torque CMD #1

Motor Torque CMD #2

Motor Torque CMD #3

Motor Torque CMD #4

Individual IGBT Faults that disable the respective drive.

DRIVE MODULE 1

Motor Torque Limit #1
Motor Torque CMD #1
Motor #1 Drive Enable
Cut Out
Enable
SR DRIVE Sel. Smallest
* SENSORLESS SPEED & POSITION CALCULATION
* CURRENT CONTROL
* CHOPPER GATING
* TEMPERATURE & FAULT REPORTING
* SYSTEM PARAMETER FB REPORTING
CHARACTERISTIC TABLE - SR
SR GATING CONTROL
CHOPPER CONTROL
PARAMETER REPORTING

CURRENT FB
BUS VOLTAGE FB
IGBT TEMP FB
IGBT FAULT FB

SR IGBT SWITCHES
CHOPPER IGBT SWITCH
BRAKE GRID
TRACTION MOTOR M1 LF

DRIVE MODULE 2

Motor Torque Limit #2
Motor Torque CMD #2
Motor #1 Drive Enable
Cut Out
Enable
SR DRIVE Sel. Smallest
* SENSORLESS SPEED & POSITION CALCULATION
* CURRENT CONTROL
* CHOPPER GATING
* TEMPERATURE & FAULT REPORTING
* SYSTEM PARAMETER FB REPORTING
CHARACTERISTIC TABLE - SR
SR GATING CONTROL
CHOPPER CONTROL
PARAMETER REPORTING

CURRENT FB
BUS VOLTAGE FB
IGBT TEMP FB
IGBT FAULT FB

SR IGBT SWITCHES
CHOPPER IGBT SWITCH
BRAKE GRID
TRACTION MOTOR M2 RF

DRIVE MODULE 3

Motor Torque Limit #3
Motor Torque CMD #3
Motor #1 Drive Enable
Cut Out
Enable
SR DRIVE Sel. Smallest
* SENSORLESS SPEED & POSITION CALCULATION
* CURRENT CONTROL
* CHOPPER GATING
* TEMPERATURE & FAULT REPORTING
* SYSTEM PARAMETER FB REPORTING
CHARACTERISTIC TABLE - SR
SR GATING CONTROL
CHOPPER CONTROL
PARAMETER REPORTING

CURRENT FB
BUS VOLTAGE FB
IGBT TEMP FB
IGBT FAULT FB

SR IGBT SWITCHES
CHOPPER IGBT SWITCH
BRAKE GRID
TRACTION MOTOR M3 LR

DRIVE MODULE 4

Motor Torque Limit #4
Motor Torque CMD #4
Motor #1 Drive Enable
Cut Out
Enable
SR DRIVE Sel. Smallest
* SENSORLESS SPEED & POSITION CALCULATION
* CURRENT CONTROL
* CHOPPER GATING
* TEMPERATURE & FAULT REPORTING
* SYSTEM PARAMETER FB REPORTING
CHARACTERISTIC TABLE - SR
SR GATING CONTROL
CHOPPER CONTROL
PARAMETER REPORTING

CURRENT FB
BUS VOLTAGE FB
IGBT TEMP FB
IGBT FAULT FB

SR IGBT SWITCHES
CHOPPER IGBT SWITCH
BRAKE GRID
TRACTION MOTOR M4 RR

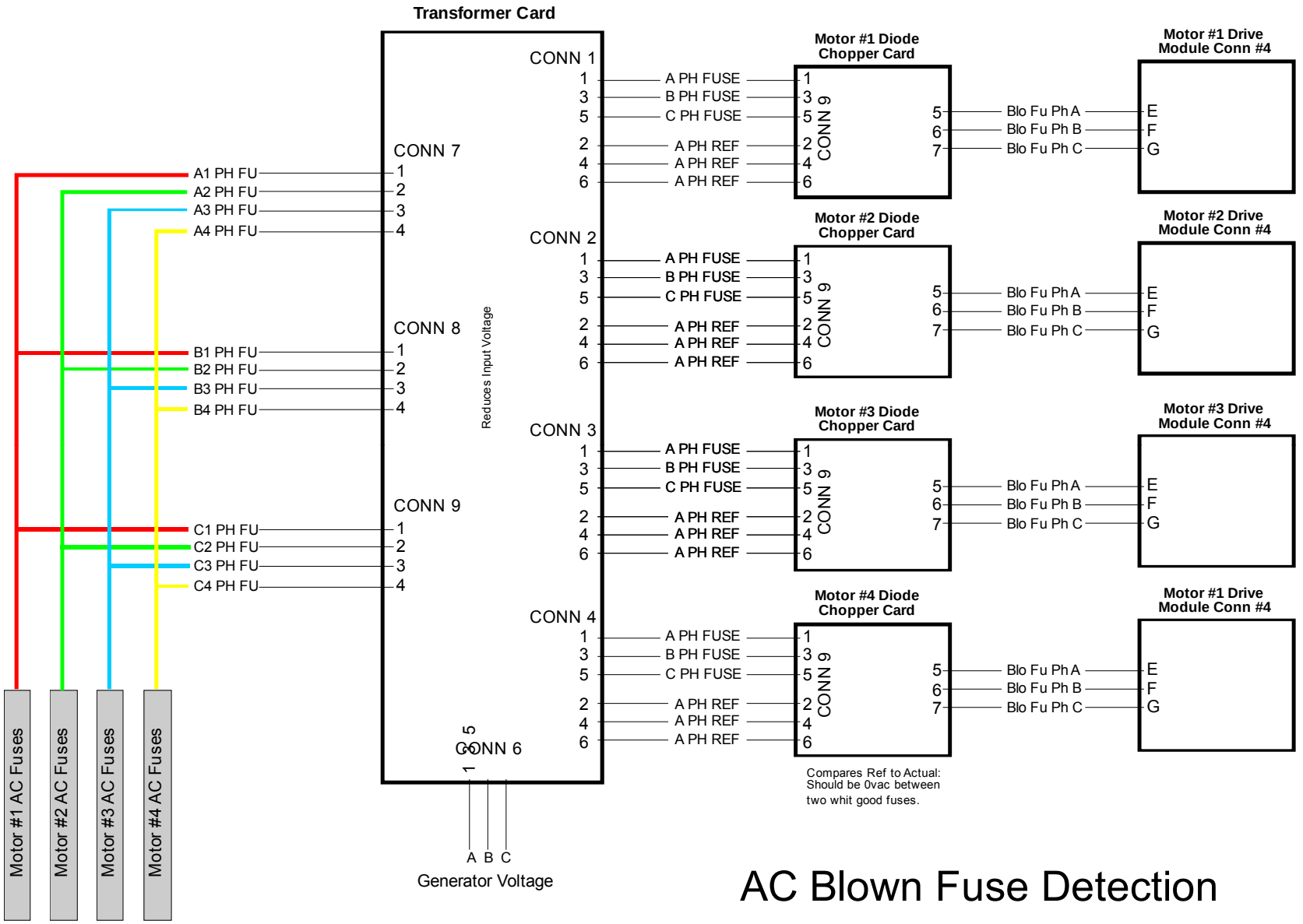
VR CONTROL

Drive Enable disables the drive is the Park Brake is se, unless in Load Bank Mode where it enables the Chopper as AC voltage reaches 150VAC.

NOTE: VR CONTROL hardware is present in all Drive Modules. It is only activated by software in Drive Module #4

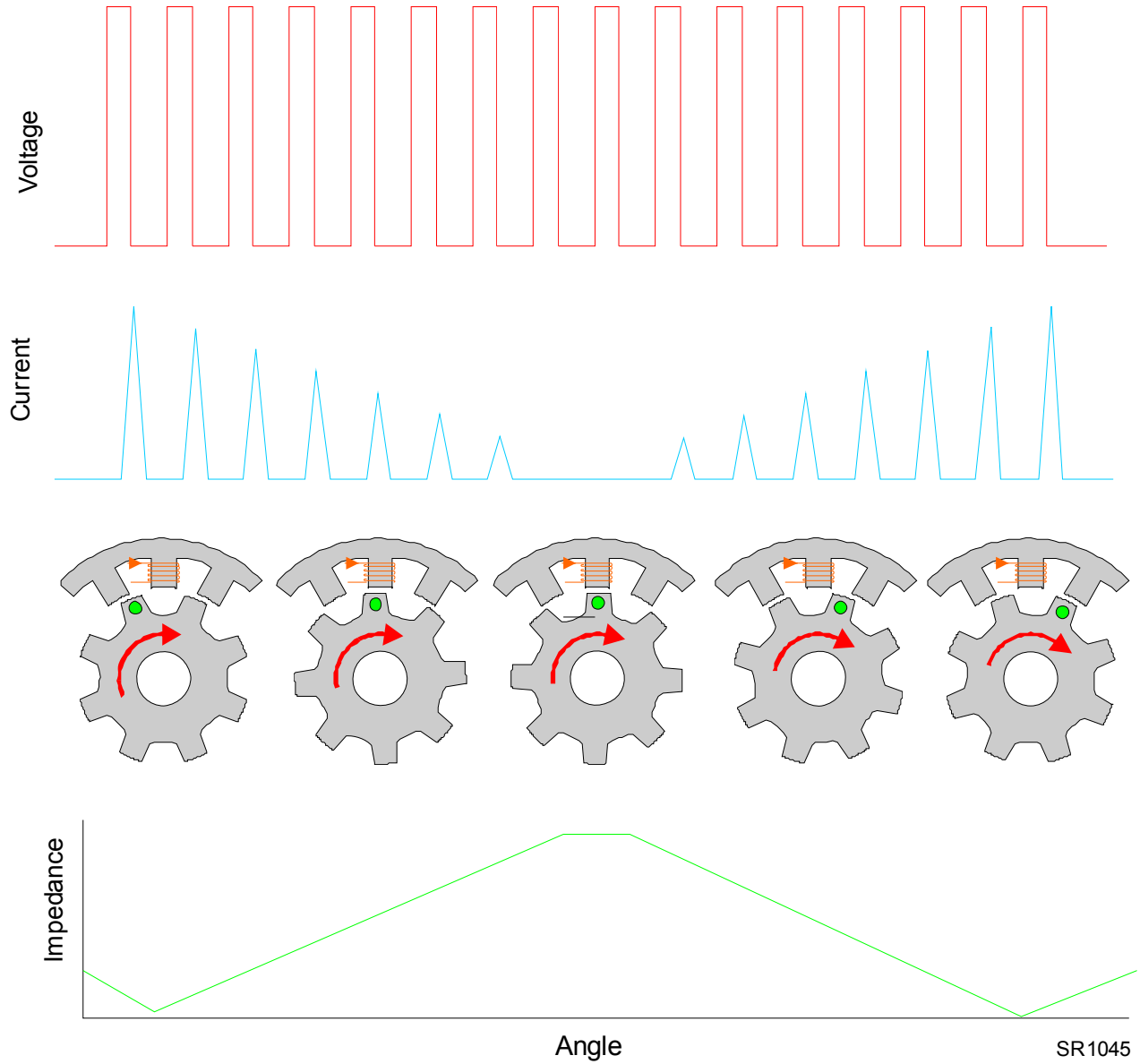
Choppers are on when DC Buss voltage reaches 700VDC
or
when in Load Bank mode and AC voltage is above 150VAC

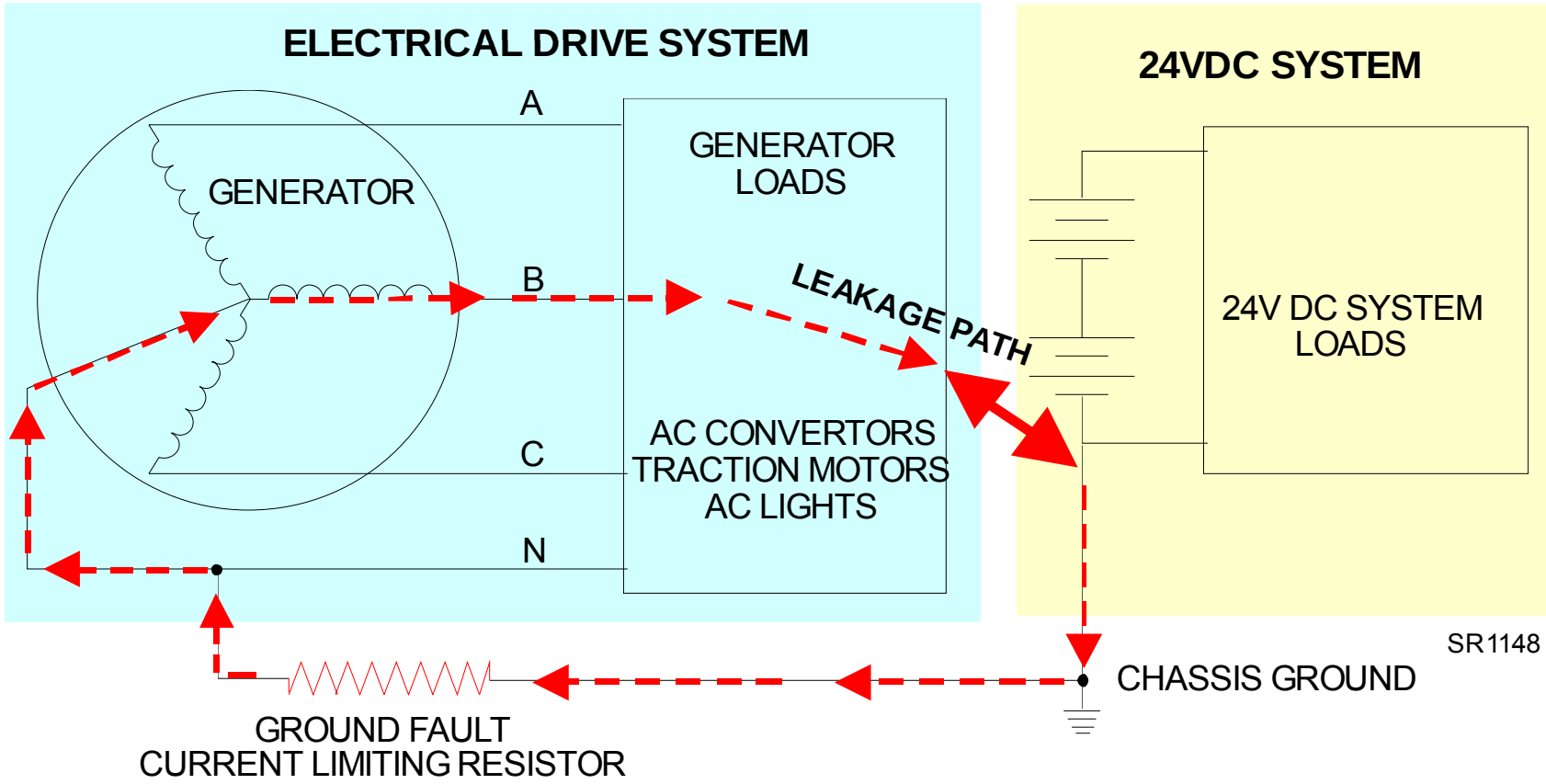
IGBT Control Logic



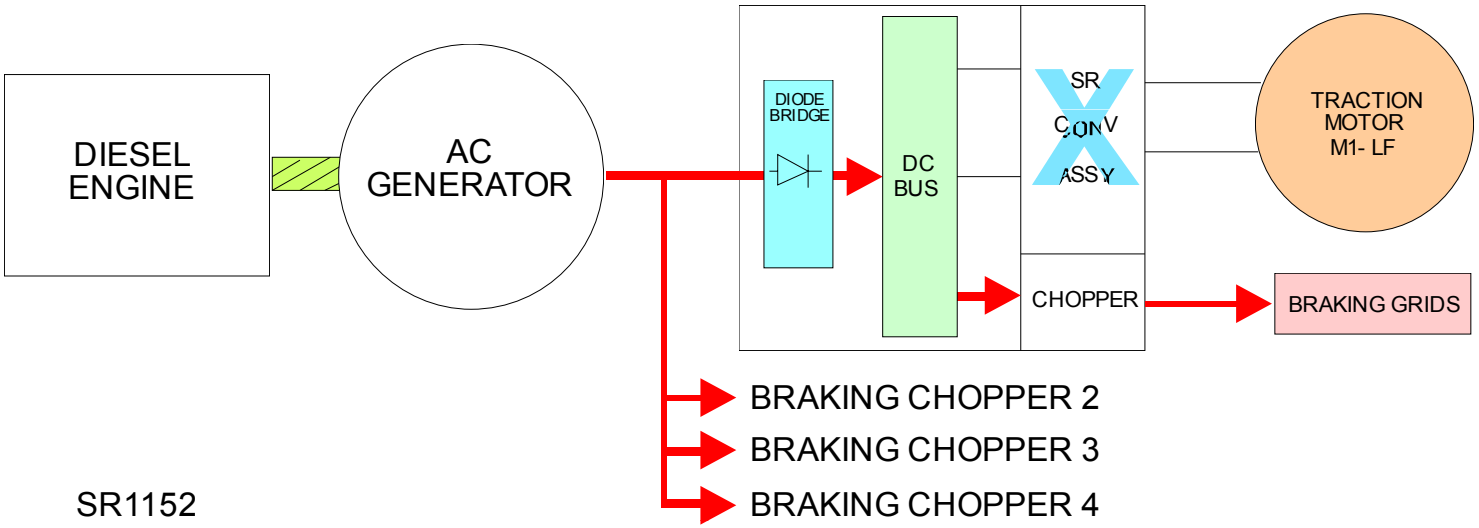
AC Blown Fuse Detection

Speed Sensing





Ground Fault Monitoring



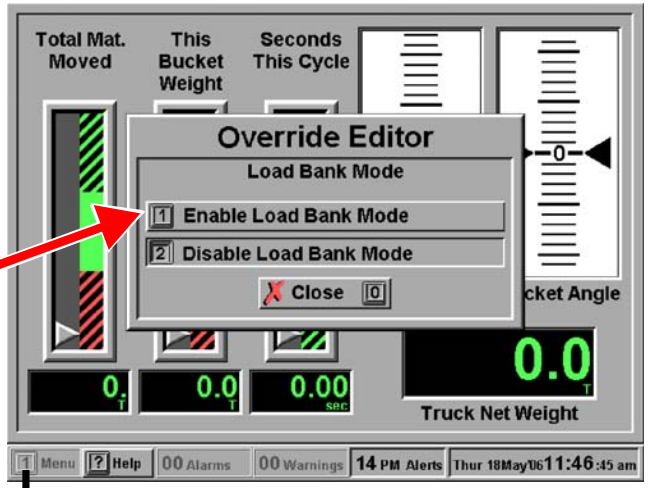
SR1152

L-950 / D-950	L-1350
Watts = $(M1DCBusVolt)^2/2.38$ + $(M2DCBusVolt)^2/2.38$ + $(M3DCBusVolt)^2/2.38$ + $(M4DCBusVolt)^2/2.38$	Watts = $(M1DCBusVolt)^2/1.82$ + $(M2DCBusVolt)^2/1.82$ + $(M3DCBusVolt)^2/1.82$ + $(M4DCBusVolt)^2/1.82$
ELECTRICAL HP = Watts/746/0.95	ELECTRICAL HP = Watts/746/0.95

With 0.95 being the generator efficiency and 746 the watts to HP ratio. This gives the approximate horsepower input to the generator.

The loads that cannot be electrically measured, the parasitics, then have to be added to the measured horsepower. This includes hydraulic loads to circulate fluid and operate fan and blower loads, air compressor, battery charger, air conditioner, etc. This has been empirically measured and is estimated to be:

L-950 at HI fan speed: 250 HP
D-950 at HI fan speed: 200 HP
L-1350 at HI fan speed: 320HP



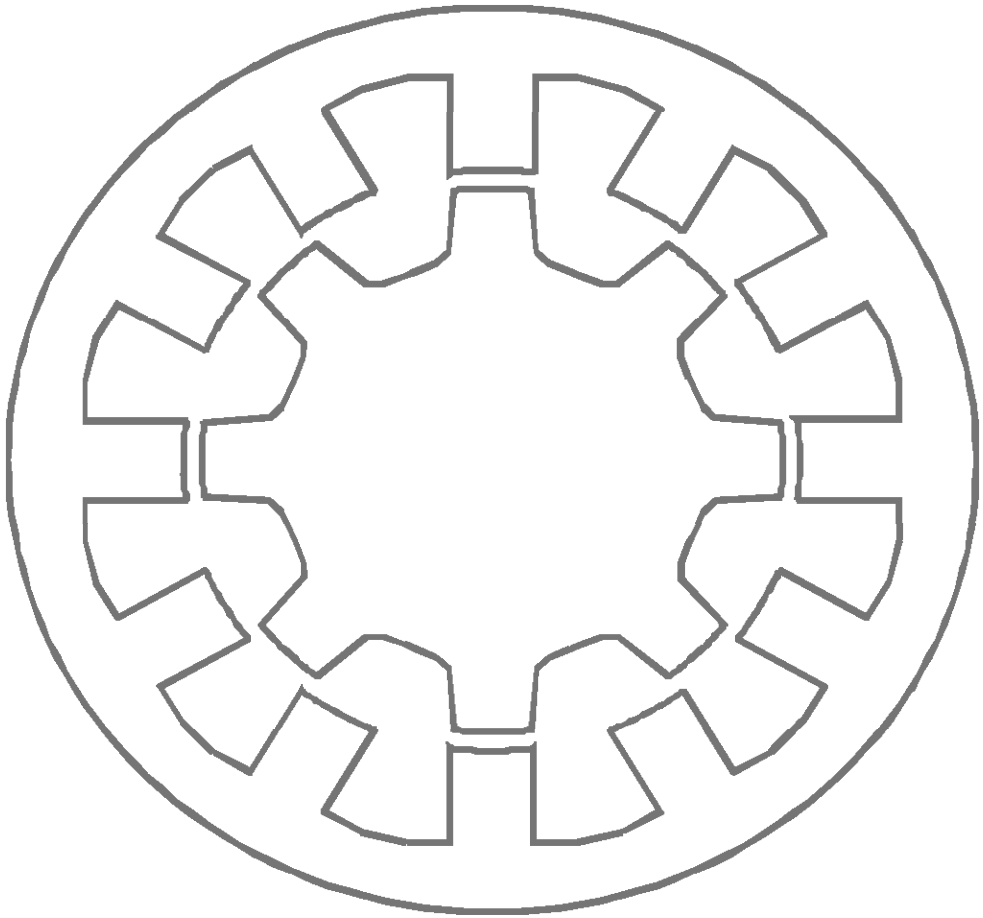
Load Bank Mode

SR 1178B

NOTES:

NOTES:

NOTES:



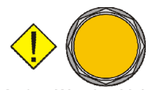
TROUBLESHOOTING

LeTourneau Technologies, Inc.

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
AC Frequency	63 Hz 1900 rpm High Throttle 60-66 hz normal operation 50 hz 1500 rpm shop mode	Active Front End	NO ALARM	N/A	N/A	N\A	N\A	N\A	N\A
AC Fuse **X** Status **(X = A, B, or C)**	AC fuse X phase on chopper panel: 0 = OK 10,000 = blown	Active Front End	**AC Fuse X Status: Blown**  Amber Warning Light	A, B or C phase fuse blown Machine continues to run on the other fuses. The bus voltage will droop under full load. Warning message only. No effect on operation other than drooping bus.	Interface card and Drive Module	When fault is cleared	Repair fault	• Blown fuse • Defective Diode/Chopper interface card • Loose wire or pin • Transformer card • Drive Module • Loss of 24V power to packages or panels	• Replace fuse • Replace Diode/Chopper interface card • Inspect/Replace wiring • Replace transformer card • Replace Drive module • Determine cause of lost 24V
AC Neutral Voltage	0-279 VAC	Active Front End	**Ground Fault**  Red Alarm Light	Ground Fault alarm at 38 VAC Disables accelerator, applies full brake boost, applies hill hold, when motor speed less than 200, engine goes to low throttle	Configuration Software	Yes	Go to low throttle then high throttle	Ground Fault High voltage circuit connected to ground Most common: • Braking grids wet or muddy • Rear door bent in against grids	Clean and dry grids Isolate and repair ground fault per procedures
AC Phase **X** Current **(X = A, B, or C)**	Not used	Active Front End	N/A	N/A	N/A	N\A	N\A	N\A	N\A
AC Supply Line Voltage This is displayed for each drive module: SR DRV **#X** AC Supply Line Voltage **(X= 1,2,3 OR 4)**	AC volts measured by Drive module based on stepped down 3 phase input from transformer board to the Drive Module. 470-505VAC under normal operation	Active Front End	**SR DRV #X: AC Supply Line Voltage: High**  Amber Warning Light	Alarms at 600V - detected by software Approximate ± 10% accuracy a stepped down to about 5V for drive module. Kills the generator voltage command immediately. Apply air brakes to stop the machine.	Software	Yes	When voltage drops	• Reading error • 6 phase transformer • Cables with pin pushed out • Diode/Chopper Interface card • Drive module	• Verify generator voltage with voltmeter. • Replace Diode/Chopper interface card • Replace Drive module • Inspect/replace interface cables. • Replace SCR's • Replace VR panel
Active Bridge Error	Not used	Active Front End	N/A	N/A	N/A	N\A	N\A	N\A	N\A
Active Bridge Temp	Not used	Active Front End	N/A	N/A	N/A	N\A	N\A	N\A	N\A

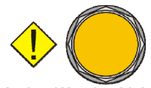
DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Active BridgeCrntCmd	Not used	Active Front End	N/A	N/A	N/A	N\A	N\A	N\A	N\A
Chopper Current	Does not exist. Never implemented.	Braking Chopper	**- NO ALARM -**	N\A	NO	N\A	N\A	N\A	N\A
Chopper Status This is displayed for each drive module: SR DRV **#X** Chopper Status **(X= 1,2,3 OR 4)**	OK = 0 Fault = 10,000	Braking Chopper	**SR DRV #X : Chopper Status Fault**  Amber Warning Light	Analog signal on the Powerex and Semikron IGBT module. Determined by internal circuitry on the Powerex or Semikron driver card. Normally accompanied by red light(s) on Powerex panel (unless it is a loose pin problem) If switch is bad – braking for that motor is lost	Chopper drive card on IGBT to drive module thru interface card and cabling	Follows the signal from IGBT	Cycle 24V (Reboot)	• Bad IGBT or driver board • Open wire from IGBT board to interface card to DM • Bad diode chopper interface card • Bad cable to chopper • Bad SR interface card • Bad cable between SR interface and diode chopper interface card • Lack of 24V supply to the SR interface card – this will typically give a status fault warning on all phases and chopper. • Bad switch or driver board	• Replace chopper panel • Check continuity for the Status signal from IGBT • Replace interface cards • Replace cables • Determine problem with 24V supply • Replace IGBT module • Replace IGBT driver board
Chopper Temp This is displayed for each drive module: SR DRV **#X** Chopper Temp **(X= 1,2,3 OR 4)**	Chopper temperature on heatsink	Braking Chopper	**SR DRV #X: Chopper Temp: High Converters Cutting Back**  Amber Warning Light	0-10V analog signal from the Semikron and Powerex packages. 0-120°C Cutback starts 85°C and gives first alarm of temperature high Converters completely off at 90°C and gives second alarm of temperature critically high	Configuration software	YES, when temp goes down to 80°C	N/A	• Airflow missing or reduced. • RTD problem • Interface card problem (Diode/Chopper) interface • Drive Module Problem • Cable problem	• Check airflow • Replace RTD • Replace card • Replace panel (Powerex) • Replace Drive Module
Chopper Temp This is displayed for each drive module: SR DRV **#X** Chopper Temp **(X= 1,2,3 OR 4)**	Chopper temperature on heatsink	Braking Chopper	**SR DRV #X: Chopper Temp: Critically High Converters Cut Off**  Amber Warning Light	0-10V analog signal from the Semikron and Powerex packages. 0-120°C Cutback starts 85°C and gives first alarm of temperature high Converters completely off at 90°C and gives second alarm of temperature critically high	Configuration software	YES, when temp goes down to 80°C	N/A	• Airflow missing or reduced. • RTD problem • Interface card problem (Diode/Chopper) interface • Drive Module Problem • Cable problem	• Check airflow • Replace RTD • Replace card • Replace panel (Powerex) • Replace Drive Module
Clockwise Torque	-100 to +100% Feedback from DM saying what it is doing. Not an actual measurement.	Drive Motor Channel	**- NO ALARM -**	N\A	NO	N\A	N\A	N\A	N\A

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Data Point # X	Reserved for Engineering use in machine development	Drive Motor Channel	Data Point # 1,2,3,4,5,6	N\A	N\A	N\A	N\A	N\A	N\A
DC Bus Current	Not used No transducer to measure	Active Front End	N/A	N/A	N/A	N\A	N\A	N\A	N\A
DC Bus Voltage This is displayed for each drive module: SR DRV **#X** DC Bus Voltage **(X= 1,2,3 OR 4)**	600-730VDC Typically • 600V full load • 660-670V unloaded • 730 braking	Active Front End	**SR DRV #X: DC Bus Voltage: High**  Amber Warning Light	DC bus overvoltage at 820VDC Shuts down the drive module for that motor. Bus for that motor is charged up by generator. There is no automatic discharge when engine goes to low throttle. Red LED will remain on for several minutes.	SR Drive Module	Yes	Reset drive Set and release park brake	• Overheated grids • Grid open • Wire open	• Keep speed within limits of grade chart • Verify fan going to high speed • Verify pressure setting of engine fan • Check grids • Check grid wiring
Diode Temp Semikron only	Semikron only Thermistor temp on the diode heatsink Cutback on all 4 wheel motors at same time – expcept in braking	Active Front End	**Diode Heatsink Temp: High** **Converters Cutting Back**  Amber Warning Light	Semikron only Diode heatsink Too hot Thermistor voltage on diode heatsink (0-10V signal) Cutback starts 85°C and gives first alarm of temperature high Converter completely off at 90°C and gives second alarm of temperature critically high	85°C is first warning and start of cutback. 90°C is second warning and fully cutbck	Yes	When temperature cools down to 80°C	• Airflow • Thermistor • Interface card	• Check airflow • Check thermistor resistance • Check wiring • Replace interface card
Diode Temp Semikron only	Semikron only Thermistor temp on the diode heatsink Cutback on all 4 wheel motors at same time – expcept in braking	Active Front End	**Diode Heatsink Temp: Critically High** **Converters Cut Off**  Amber Warning Light	Semikron only Diode heatsink Too hot Thermistor voltage on diode heatsink (0-10V signal) Cutback starts 85°C and gives first alarm of temperature high Converter completely off at 90°C and gives second alarm of temperature critically high	85°C is first warning and start of cutback. 90°C is second warning and fully cutbck	Yes	When temperature cools down to 80°C	• Airflow • Thermistor • Interface card	• Check airflow • Check thermistor resistance • Check wiring • Replace interface card

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Direction Cmd	Command for Torque direction Fwd = 0 Rev = 10,000	Drive Motor Channel	**- NO ALARM -**	Direction select information from LINCS	NO	N\A	N\A	N\A	N\A
Drive Enable Cmd	Command to turn Drive Module on and off. Run = 0 Off = 10,000	Drive Motor Channel	**- NO ALARM -**	SR Drive Run Generator in Configuration Software	NO	N\A	N\A	N\A	N\A
Drive State This is displayed for each drive module: SR DRV **#X** DC Drive State **(X= 1,2,3 OR 4)**	State of the Drive Module 0=Fault 8 = Standby (at boot up) 10=Enabled (park brake released + generator volts)	Drive Motor Channel	**SR DRV #X: Drive State Fault**  Amber Warning Light	Drive Module did not reach the "Run" State (10) Any number less than 4 produces the alarm message Drive is turned off. No power or braking from the Drive Module.	SR Drive Code Drive module	Yes	Reset Drive Module Set and release park brake	Drive module failure	If problem persists and stays with a drive module, swap two drive modules to see if problem follows. If problem follows, replace drive module.
Gen Overvoltage SR DRV **#4**	0 = under 565VAC 10,000 = over 565VAC No voltage value given with this overvoltage alarm (Active only on Drive Module 4)	VR	**AC Overvoltage: Fault**  Amber Warning Light	Trip circuit on VR interface card at 565VAC. Hardware grounding to 0 the SCR firing signals and report to LINCS of Overvoltage fault. This is a digital on/off hardware circuit. Apply air brakes to stop the machine.	VR Interface Card Gives 0, 10,000 in LINCS display	Yes	Low Throttle	• Reading error • 6 phase transformer • Cables with pin pushed out • VR Interface card • Drive module	• Verify generator voltage with voltmeter. • Replace VR interface card • Replace SCR's • Replace VR panel • Replace Drive module • Inspect/replace interface cables.

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Generator Field Cmd SR DRV **#4**	Command to the VR panel in degrees 20° to 160° Typically 80°-90° with generator unloaded Moves to about 70° at full load. May spike to about 40° under a sudden load. (Active only on Drive Module 4)	VR	**- NO ALARM -**	20° = full on , phase forward 160° = phase back – absorbing field energy	NO	N\A	N\A	N\A	N\A
Generator Field Current SR DRV **#4**	Rotor current 0-200 A range Approx 20-90A on L1350 Approx 20-150A` on L950 Active only on Drive Module 4	VR	**- NO ALARM -**	N/A	NO	N\A	N\A	N\A	N\A
Generator Field Voltage SR DRV **#4**	Voltage across 7-N OP amp not calibrated (Active only on Drive Module 4)	VR	**- NO ALARM -**	Only an approximate value	NO	N\A	N\A	N\A	N\A
Generator Prime Enable	Provides 24V to energize the prime relay and close its contacts. This relay is located on the left side of the Voltage Regulator panel. This signal will normally go off in about 5 seconds if prime is functioning correctly.	Remote Module	**Generator Prime Enable High**  Amber Warning Light	The Generator Prime Enable has remained high for more than 30 seconds If it does not go low within 30 seconds then an alarm is called. This typically means the generator has not primed properly. If prime has failed there will be no AC voltage. No propel	Configuration	< +4.00 for .5 seconds	Turns off when Master receives End of Priming message	• Prime Relay not working • Cabling defective • Remote Module not working • Drive Module not reporting end of priming	• Check Generator Prime Voltage in LINCS. • Check Generator Prime Voltage at the prime relay • Test /Replace Prime Relay • Test wiring between remote and Prime relay • Replace Remote Module\ • Replace Drive Module • Replace VR panel

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Generator Temperature X X = 1,2,3	Generator temperature in the slots between coils.	LINCS	**Generator Temperature X: High**  Amber Warning Light Accompanied by hint that says **Converters Cutting Back**	The generator temperature is greater than 190°C (374°F) for more than .5 seconds At this point the commands to the respective packages will start to be ramped back. **The machine should be stopped immediately as power for propel and retarding will start to be cut back.**	Settings in LINCS configuration	Yes - automatically	Reduce temperature below 180°C for .5 seconds	• RTD failure • Generator too hot • Lack of airflow • Generator failing	• Inspect RTD and use one of the spares. • Measure actual generator temperature • Check airflow • Check KLENZ • Check blower wheel, blower speed, motor and adapter • Inspect generator • Replace generator
Generator Temperature X X = 1,2,3	Generator temperature in the slots between coils.	LINCS	**Generator Temperature X: Critically High**  Amber Warning Light Accompanied by hint that says **Converters Cutting Back**	The generator temperature is greater than 200°C (392°F) for more than .5 seconds At this point the commands to the respective packages will start to be cut off completely. **The machine should be stopped immediately as power for propel and retarding will be off.**	Settings in LINCS configuration	Yes - automatically	Reduce temperature below 190°C for .5 seconds	• RTD failure • Generator too hot • Lack of airflow • Generator failing	• Inspect RTD and use one of the spares. • Measure actual generator temperature • Check airflow • Check KLENZ • Check blower wheel, blower speed, motor and adapter • Inspect generator • Replace generator
Generator Voltage (Signal is called “AC Volts” from Diode Chopper Interface card to Drive Module) SR DRV **#4**	Generator voltage feedback From 6 phase transformer on transformer card. (only 3 phases used) 3 phase signals are combined to an analog signal on Diode/Chopper interface card. 470-505 VAC 950 480-495 VAC 1350 (Slight boost given when loaded) (Active only on Drive Module 4)	VR and Drive Module	**SR DRV #4: AC Over Voltage: High**  Amber Warning Light	Configuration software. Alarms when > 600V for more than .1 second Takes Generator command to 0 immediately. No generator voltage or braking or power. Apply service brakes to stop.	VGEN feedback AC Line Voltage Feedback Logic on VR interface card	Resets when voltage is below 525 for more than .1 seconds	Re-prime generator. Go to low throttle and then to high.	• Reading error • 6 phase transformer • Cables with pin pushed out • Diode/Chopper Interface card • Drive module • Loss of feedback	• Verify generator voltage with voltmeter. • Replace Diode/Chopper interface card • Replace SCR’s • Replace VR panel • Replace Drive module • Inspect/replace interface cables. • Verify the VR feedback wiring with the VR troubleshooting procedure.

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Generator Voltage (Signal is called "AC Volts" from Diode Chopper Interface card to Drive Module) SR DRV **#4**	Generator voltage feedback From 6 phase transformer on transformer card. (only 3 phases used) 3 phase signals are combined to an analog signal on Diode/Chopper interface card. 470-505 VAC 950 480-495 VAC 1350 (Slight boost given when loaded) (Active only on Drive Module 4)	VR and Drive Module	**SR DRV #4: Generator Control Fault: High**  Amber Warning Light	Compares Generator Voltage Command Echo to Generator Voltage. If the commands is more than 50VAC higher than the actual voltage for 2 seconds Warning message only. No effect on operation.	LINCS	Resets when the difference is less than 40VAC for .5 seconds	Clear the fault	• Reading error • 6 phase transformer • Cables with pin pushed out • VR Interface card • Drive module • Loss of feedback • Engine rpm not correct	• Verify Generator Voltage and Generator Voltage Command Echo. • Verify engine rpm is correct • Verify generator voltage with voltmeter. • Replace VR interface card • Replace SCR's • Replace VR panel • Replace Drive module • Inspect/replace interface cables. • Check wiring from the generator to the transformer board
Generator Voltage (Signal is called "AC Volts" from Diode Chopper Interface card to Drive Module) SR DRV **#4**	Generator voltage feedback From 6 phase transformer on transformer card. (only 3 phases used) 3 phase signals are combined to an analog signal on Diode/Chopper interface card. 470-505 VAC 950 480-495 VAC 1350 (Slight boost given when loaded) (Active only on Drive Module 4)	VR and Drive Module	**SR DRV #4: Generator Control Fault: Low**  Amber Warning Light	Compares Generator Voltage Command Echo to Generator Voltage. If the command is more than 50VAC lower than the actual voltage for 2 seconds. Warning message only. No effect on operation.	LINCS	Resets when the difference is less than 40VAC for .5 seconds	Clear the fault	• Reading error • 6 phase transformer • Cables with pin pushed out • VR Interface card • Drive module • Loss of feedback • Engine rpm not correct	• Verify Generator Voltage and Generator Voltage Command Echo. • Verify engine rpm is correct • Verify generator voltage with voltmeter. • Replace VR interface card • Replace SCR's • Replace VR panel • Replace Drive module • Inspect/replace interface cables. • Check wiring from the generator to the transformer board
Generator Voltage (Signal is called "AC Volts" from Diode Chopper Interface card to Drive Module) SR DRV **#4**	Generator voltage feedback From 6 phase transformer on transformer card. (only 3 phases used) 3 phase signals are combined to an analog signal on Diode/Chopper interface card. 470-505 VAC 950 480-495 VAC 1350 (Slight boost given when loaded) (Active only on Drive Module 4)	VR and Drive Module	**SR DRV #4: Generator Voltage Fault**  Amber Warning Light	Looks at generator voltage level when the Voltage Regulator has been disabled. >100VAC for > than 10 seconds VR is disabled by Prime Enable Timeout or by the Throttle Switch going to low. In either of these cases there should not be any voltage	LINCS	Resets when value is less than 50VAC for more than .5 seconds	Clear the fault	• Defective VR interface card • Problem with VR panel • Defective Remote • Defective Drive Module • Software problem • Throttle Switch defective • Wiring	• Replace VR interface card • Replace VR panel • Replace Drive module • Replace remote that carries the Prime Enable signal (check machine schematic) • Inspect/replace interface cables. • Check wiring from the generator to the transformer board

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Greatest Converter Temp	For a given drive module. Looks at all of the IGBT swtich temps and picks the greatest	Drive Motor Channel	**- NO ALARM -** (Alarms are on individual temperature levels)	Temperatures on the IGBT switch modules. Used to generate the torque reduction signals	NO	N\A	N\A	N\A	N\A
Internal Drive Fault Internal to Drive Module	Not visible in LINCS	Drive Module Hardware	**Inernal Drive Fault # XX**  Amber Warning Light	Internal failure to the drive module XX will be a code number related to a specific problem. All faults listed this way are not used in the LeTourneau drive system and should never appear. If they appear – the drive module has likely failed	SR Drive Code SR Drive module	Maybe	Reset Drive Module Set and release park brake If this does not work – then reboot.	Defective Drive Module	IF problem persists replace drive module.
Master **X (XX) =** **1 (LF)** **2 (RF)** **3 (LR)** **4 (RR)**	Message when one or more motors have been disabled in LINCS menus	Master	**Motor X (XX) Disabled – Braking Effort Reduced**  Amber Warning Light	Motor has been disabled in LINCS menus. This comes up each time the park brake is released to remind the operator that a motor is disabled. CAUTION: 25% of torque and braking is gone for each motor disabled. This is followed by a blue information screen that says **Motor Disabled by Maintenance Personnel.**	Master	Enable motor in LINCS menus	Message	Someone has disabled a motor in LINCS menus	Slow down on grade
Motor Spd&Direction	-5000 - 0 - +5000 rpm Left motors - Fwd is pos, Right motors – Fwd is neg (motors turning in reverse)	Drive Motor Channel	**- NO ALARM -**	Motor speed and direction	NO	N\A	N\A	N\A	N\A
Motor Speed Absolute	0-5000 rpm Always positive. From Drive Module	Drive Motor Channel	**- NO ALARM -**		NO	N\A	N\A	N\A	N\A

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Motor Speed Cmd	0-4500 rpm “0” is the only command that is used or means anything.	Drive Motor Channel	**- NO ALARM -**	Only used in Hill Hold Mode. Only 0 command is used. All other numbers are NOT used.New configurations load 0 when booting.	NO	N\A	N\A	N\A	N\A
Motor Temperature **XX** **(XX= LF, RF, LR or RR)**	Temperature of the respective motor	Remote Module	**Motor Temperature XX High**  Amber Warning Light	The respective motor temperature is greater than 121°C (250°F) for more than .5 seconds At this point the commands to the respective packages will start to be ramped back. **The machine should be stopped immediately as power for propel and retarding will start to be cut back.**	Configuration	< 119°C (246°F) for .5 seconds	Cool off motor	• Insufficient or blocked airflow • Blower motor defective • Blower wheel broken • Motor RTD defective • Cable problem between Remote Module and motor. • Brakes locked up • Motor defective	• Check air lines for obstruction • Check axle air outlets for obstruction • Replace blower motor • Replace blower wheel • Check blower rpm and pressure settings • Check motor RTD • Swap to another RTD (3 on motor) • Check cables between Remote Module and motor • Check brakes • Replace motor
Motor Temperature **XX** **(XX= LF, RF, LR or RR)**	Temperature of the respective motor	Remote Module	**Motor Temperature XX Critically High**  Amber Warning Light	The respective motor temperature is greater than 129°C (264°F) for more than .5 seconds This will hold the commands at 0 for the respective motor packages. **The machine should be stopped immediately as power for propel and retarding will be completely off.**	Configuration	< 127°C (261°F) for .5 seconds	Cool off motor	• Insufficient or blocked airflow • Blower motor defective • Blower wheel broken • Motor RTD defective • Cable problem between Remote Module and motor. • Brakes locked up • Motor defective	• Check air lines for obstruction • Check axle air outlets for obstruction • Replace blower motor • Replace blower wheel • Check blower rpm and pressure settings • Check motor RTD • Swap to another RTD (3 on motor) • Check cables between Remote Module and motor • Check brakes • Replace motor
Motor Torque Cmd	Variable 0-100% maximum range 0-72% on L-950 0-80% on D-950 0-80% on L-950	Drive Motor Channel	**- NO ALARM -**	LINCS drive controls and limits 100% is a curve that is maximum capability of the B-40 motor. Curves are reduced to match driver capability.	NO	N\A	N\A	N\A	N\A

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
NEG 15V supply Internal to Drive Module This is displayed for each drive module: SR DRV **#X** NEG 15V Supply **(X= 1,2,3 OR 4)**	Not visible in LINCS	Drive Module Hardware	**SR DRV #X: NEG 15V SUPPLY: FAULT**  Amber Warning Light	SR Drive module lost -15V power Alarms if greater than -12.5V On-board DC-DC converter that receives power from CAN bus. This message rare as the drive module likely dead by this stage.	SR Drive module	Yes, if power did not droop such that SR module quit communicating with master.	Cycle park brake switch	• CAN bus • SR Drive Module	• Check/repair CAN bus 24V supply if all modules on chain have failed due to loss of digital power. • If alarm is received by a single SR drive module, replace module.
Neg Motor Spd&Direction	-5000 to 0 to +5000 rpm Opposite of motor speed and direction. Used for CSV electrochart so all motors appear to be going same direction on charting	Drive Motor Channel	**- NO ALARM -**	N\A	NO	N\A	N\A	N\A	N\A
Overspeed Coast Internal to Drive Module This is displayed for each drive module: SR DRV **#X** Overspeed Fault **(X= 1,2,3 OR 4)**	Not visible in LINCS	Drive Module Hardware	**SR DRV #X: OVERSPEED COAST** (Set at 6000 rpm)  Amber Warning Light	SR Drive Code Calculated motor speed as set in configuration for overspeed was exceeded Shuts the drive off.	SR Drive module	Yes	Reset Drive Module Reboot	Machine runaway condition	Operate machine within speed and grade limits on grade chart. If problem persists, and machine was not in a run away condition, return and replace drive module.
Overspeed Fault Internal to Drive Module This is displayed for each drive module: SR DRV **#X** Overspeed Fault **(X= 1,2,3 OR 4)**	Not visible in LINCS	Drive Module Hardware	**SR DRV #X: OVERSPEED FAULT**  Amber Warning Light	Motor speed exceeded 5030 rpm Sensorless algorithm or Master	SR Drive module	No, SR drive module will continue to report overspeed until adequate bus voltage is present.	N/A	• DC bus Voltage • Steep grade • SR sensorless glitch – false speed signal	• 1350 exceeded 11 mph. • 950 exceeded 16.6 mph • Replace Drive Module

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Phase **Y** Current **(Y= 1,2 or 3)** This is displayed for each drive module: SR DRV **#X** Phase Y Current **(X= 1,2,3 OR 4)**	Amps 1v = 250A externally Analog signal from IGBT. Comes from current transformer in the IGBT module.	Drive Motor Channel	**SR DRV #X: PHASE Y CURRENT: FAULT**  Amber Warning Light	1190A for more than 6 microseconds was detected on indicated phase. Typically means a shorted IGBT or diode. Filtered and attempts to sample waveform. Only to look at in LINCS. Not used in configuration for control.	SR Drive module hardware circuit. Current signal output from Powerex or Semikron phase leg package.	Yes	Cycle park brake switch *Caution: resetting this alarm can cause major damage to IGBT.	• Shorted IGBT or Diode on indicated motor and phase • SR Drive module • Interface Cards • 14-pin connector • Cabling • Shorted wires • Short between apples in axle • Bad coil in motor	• Check for shorted IGBT with VOM. Replace drive module • Iinspect/change interface boards • Inspect/replace and cable. • Verify 14-pin connectors are intact • Inspect connectors for pins bent or pushed out • Inspect apples in axle • Inspect motor
Phase **Y** High Switch Status **(Y= 1,2 or 3)** This is displayed for each drive module: SR DRV **#X** Phase Y High Switch Status **(X= 1,2,3 OR 4)**	OK = 0 Fault = 10,000 Does not shut anything down. Open wire can cause same problem	Drive Motor Channel	**SR DRV #X: Phase Y High Switch Status: Fault**  Amber Warning Light	Analog signal from the Powerex and Semikron IGBT module. Determined by internal circuitry on the Powerex or Semikron driver card. Accompanied by red light on Powerex panel	IGBT Driver Card	Whenever fault clears	Whenever fault clears	• Pin pushed out or open in IGBT wiring harness • Bent pins • Loose cable connector • IGBT connector cable disconnected • Red light on Panel (Powerex) • Drive module failure • Interface card failure • Lack of 24V supply to the SR interface card – this will typically give a status fault warning on all phases and chopper. • Bad switch or driver board	• Check cables for loose pins and repair • Check cables for security • Swap/replace drive module • Replace panel • Replace SR interface card • Determine problem with 24V supply • Replace IGBT module • Replace driver board
Phase **Y** High Switch Temp **(Y= 1,2 or 3)** This is displayed for each drive module: SR DRV **#X** Phase Y High Switch Temp **(X= 1,2,3 OR 4)**	Temperature on IGBT heatsink	Drive Motor Channel	**SR DRV #X: Phase Y High Switch Temp: High Converters Cutting Back**  Amber Warning Light	0-10V analog signal from the Semikron and Powerex packages. 0-120°C Cutback starts 85°C and gives first alarm of temperature high Converters completely off at 90°C and gives second alarm of temperature critically high	Configuration Software	YES, when temp goes down to 80°C	Cool down	• Airflow missing or reduced. • RTD problem • Interface card problem (Diode/Chopper) interface • Drive Module Problem • Cable problem	• Check airflow • Replace RTD • Replace card • Replace panel (Powerex) • Replace Drive Module
Phase **Y** High Switch Temp **(Y= 1,2 or 3)** This is displayed for each drive module: SR DRV **#X** Phase Y High Switch Temp **(X= 1,2,3 OR 4)**	Temperature on heatsink	Drive Motor Channel	**SR DRV #X: Phase Y High Switch Temp: Critically High** **Converters Cut Off**  Amber Warning Light	0-10V analog signal from the Semikron and Powerex packages. 0-120°C Cutback starts 85°C and gives first alarm of temperature high Converters completely off at 90°C and gives second alarm of temperature critically high	Configuration Software	YES, when temp goes down to 80°C	Cool down	• Airflow missing or reduced. • RTD problem • Interface card problem (Diode/Chopper) interface • Drive Module Problem • Cable problem	• Check airflow • Replace RTD • Replace card • Replace panel (Powerex) • Replace Drive Module

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Phase **Y** Low Switch Status **(Y= 1,2 or 3)** This is displayed for each drive module: SR DRV **#X** Phase Y Low Switch Status **(X= 1,2,3 OR 4)**	NOT USED ON POWEREX ONLY ON SEMIKRON OK = 0 Fault = 10,000 Does not shut anything down. Open wire can cause same problem	Drive Motor Channel	**SR DRV #X: Phase Y Low Switch Status: Fault**  Amber Warning Light	Analog signal from the Powerex and Semikron IGBT module. Determined by internal circuitry on the Powerex or Semikron driver card. Typically accompanied by red light on Powerex panel	IGBT Driver Card	Whenever fault clears	Whenever fault clears	• Pin pushed out or open in IGBT wiring harness • Bent pins • Loose cable connector • IGBT connector cable disconnected • Red light on Panel (Powerex) • Drive module failure • Interface card failure	• Check cables for loose pins and repair • Check cables for security • Swap/replace drive module • Replace panel • Replace interface card
Phase **Y** Low Switch Temp **(Y= 1,2 or 3)** This is displayed for each drive module: SR DRV **#X** Phase Y Low Switch Temp **(X= 1,2,3 OR 4)**	Temperature on heatsink NOT USED ON POWEREX ONLY ON SEMIKRON	Drive Motor Channel	**SR DRV #X: Phase Y Low Switch Temp: High Converters Cutting Back**  Amber Warning Light	0-10V analog signal from the Semikron and Powerex packages. 0-120°C Cutback starts 85°C and gives first alarm of temperature high Converters completely off at 90°C and gives second alarm of temperature critically high	Configuration Software	YES, when temp goes down to 80°C	Cool down	• Airflow missing or reduced. • RTD problem • Interface card problem (Diode/Chopper) interface • Drive Module Problem • Cable problem	• Check airflow • Replace RTD • Replace card • Replace panel (Powerex) • Replace Drive Module
Phase **Y** Low Switch Temp **(Y= 1,2 or 3)** This is displayed for each drive module: SR DRV **#X** Phase Y Low Switch Temp **(X= 1,2,3 OR 4)**	Temperature on heatsink NOT USED ON POWEREX ONLY ON SEMIKRON	Drive Motor Channel	**SR DRV #X: Phase Y Low Switch Temp: Critically High Converters Cut Off**  Amber Warning Light	0-10V analog signal from the Semikron and Powerex packages. 0-120°C Cutback starts 85°C and gives first alarm of temperature high Converters completely off at 90°C and gives second alarm of temperature critically high	Configuration Software	YES, when temp goes down to 80°C	Cool down	• Airflow missing or reduced. • RTD problem • Interface card problem (Diode/Chopper) interface • Drive Module Problem • Cable problem	• Check airflow • Replace RTD • Replace card • Replace panel (Powerex) • Replace Drive Module

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
POS 15V SUPPLY Internal to Drive Module This is displayed for each drive module: SR DRV **#X** POS 15V SUPPLY **(X= 1,2,3 OR 4)**	Not visible in LINCS	Drive Module Hardware	**SR DRV #X: POS 15V SUPPLY: FAULT**  Amber Warning Light	SR Drive module lost 15V power Alarms if less than 11.08V `On-board DC-DC converter that receives power from CAN bus. Typically the drive module will cease to operate at about same time as the alarm so this alarm will be rare.	SR Drive module	Yes, if power did not droop such that SR module quit communicating with master.	Cycle park brake switch	• CAN bus • SR Drive Module	• Check/repair CAN bus 24V supply if all modules on chain have failed due to loss of digital power. • If alarm is received by a single SR drive module, replace module.
POS 24V Supply Internal to Drive Module This is displayed for each drive module: SR DRV **#X** POS 24V SUPPLY **(X= 1,2,3 OR 4)**	Not visible in LINCS	Drive Module Hardware	**SR DRV #X: POS 24V SUPPLY: FAULT**  Amber Warning Light	SR Drive module lost 24V power Alarms if less than 12.5V On-board DC-DC converter that receives power from CAN bus. Typically the drive module will cease to operate at about same time as the alarm so this alarm will be rare.	SR Drive module	Yes, if power did not droop such that SR module quit communicating with master.	Cycle park brake switch	• CAN bus • SR Drive Module	• Check/repair CAN bus 24V supply if all modules on chain have failed due to loss of digital power. • If alarm is received by a single SR drive module, replace module.
POS 5V supply Internal to Drive Module This is displayed for each drive module: SR DRV **#X** POS 15V SUPPLY **(X= 1,2,3 OR 4)**	Not visible in LINCS	Drive Module Hardware	**SR DRV #X: POS 5V SUPPLY: FAULT**  Amber Warning Light	SR Drive module lost 5V power Alarms if less than 4.75V On-board DC-DC converter that receives power from CAN bus. Typically the drive module will cease to operate at about same time as the alarm so this alarm will be rare.	SR Drive module	Yes, if power did not droop such that SR module quit communicating with master.	Cycle park brake switch	• CAN bus • SR Drive Module	• Check/repair CAN bus 24V supply if all modules on chain have failed due to loss of digital power. • If alarm is received by a single SR drive module, replace module.
Power To Grids	HP reading for horsepower to grids during load bank mode 0-300 HP	Braking Chopper	**- NO ALARM -**	Calculated value from Bus voltage squared divided by resistance divided by efficiency.	NO	N/A	N/A	ONLY functions in Load Bank Mode	
Propel Torque	-100% to + 100% Feedback from Drive Module characterization commanding angle and amplitude for that torque 0-72% L950 0-80% D950 and L1350	Drive Motor Channel	**- NO ALARM -**	Slight time delay. Should be same as Motor Torque Command.	NO	N\A	N\A	N\A	N\A

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
Regen Fuse Status	Not used	Active Front End	N/A	N/A	N/A	N\A	N\A	N\A	N\A
Reverse Current Internal to Drive Module	Not visible in LINCS	Drive Module Hardware	N/A	N/A	N/A	N\A	N\A	N\A	N\A
Spare Temp	Not used	Active Front End	N/A	N/A	N/A	N\A	N\A	N\A	N\A
Spd/Torq Mode Cmd	Speed Mode or Torque mode Speed = 10,000 Torque = 0	Drive Motor Channel	**- NO ALARM -**	Default is Torque Mode Speed mode command only for hill hold mode Always 0 rpm when in hill hold.	NO	N\A	N\A	N\A	N\A
SR DRV **#X** **(X= 1,2,3 OR 4)**	INFORMATION ABOUT DRIVE MODULE	DRIVE MODULE	**SR DRV #X: BOOT CRC ERROR**  Red Alarm Light	Problem with the Cyclic Redundancy Checksum or CRC. This is a mathematical check that checks boot information for data corruption. Typically would happen at boot up.	Drive Module	NO	Reboot	• Defective Drive Module • Defective Master • Defective Configuration	• Reboot and see if clears – if persistent continue with next steps • Install a good Restore Point • Replace Drive Module • Replace Master
SR DRV **#X** **(X= 1,2,3 OR 4)**	INFORMATION ABOUT DRIVE MODULE	DRIVE MODULE	**SR DRV #X: CONFIG CRC ERROR**  Red Alarm Light	Problem with the Cyclic Redundancy Checksum or CRC. This is a mathematical check that checks configuration information for data corruption. Typically would happen at boot up.	Drive Module	NO	Reboot	• Defective Drive Module • Defective Master • Defective Configuration	• Reboot and see if clears – if persistent continue with next steps • Install a good Restore Point • Replace Drive Module • Replace Master
SR DRV **#X** **(X= 1,2,3 OR 4)**	INFORMATION ABOUT DRIVE MODULE	DRIVE MODULE	**SR DRV #X: LOG CRC ERROR**  Red Alarm Light	Problem with the Cyclic Redundancy Checksum or CRC. This is a mathematical check that checks log information for data corruption. Typically would happen at boot up.	Drive Module	NO	Reboot	• Defective Drive Module • Defective Master • Defective Configuration	• Reboot and see if clears – if persistent continue with next steps • Install a good Restore Point • Replace Drive Module • Replace Master

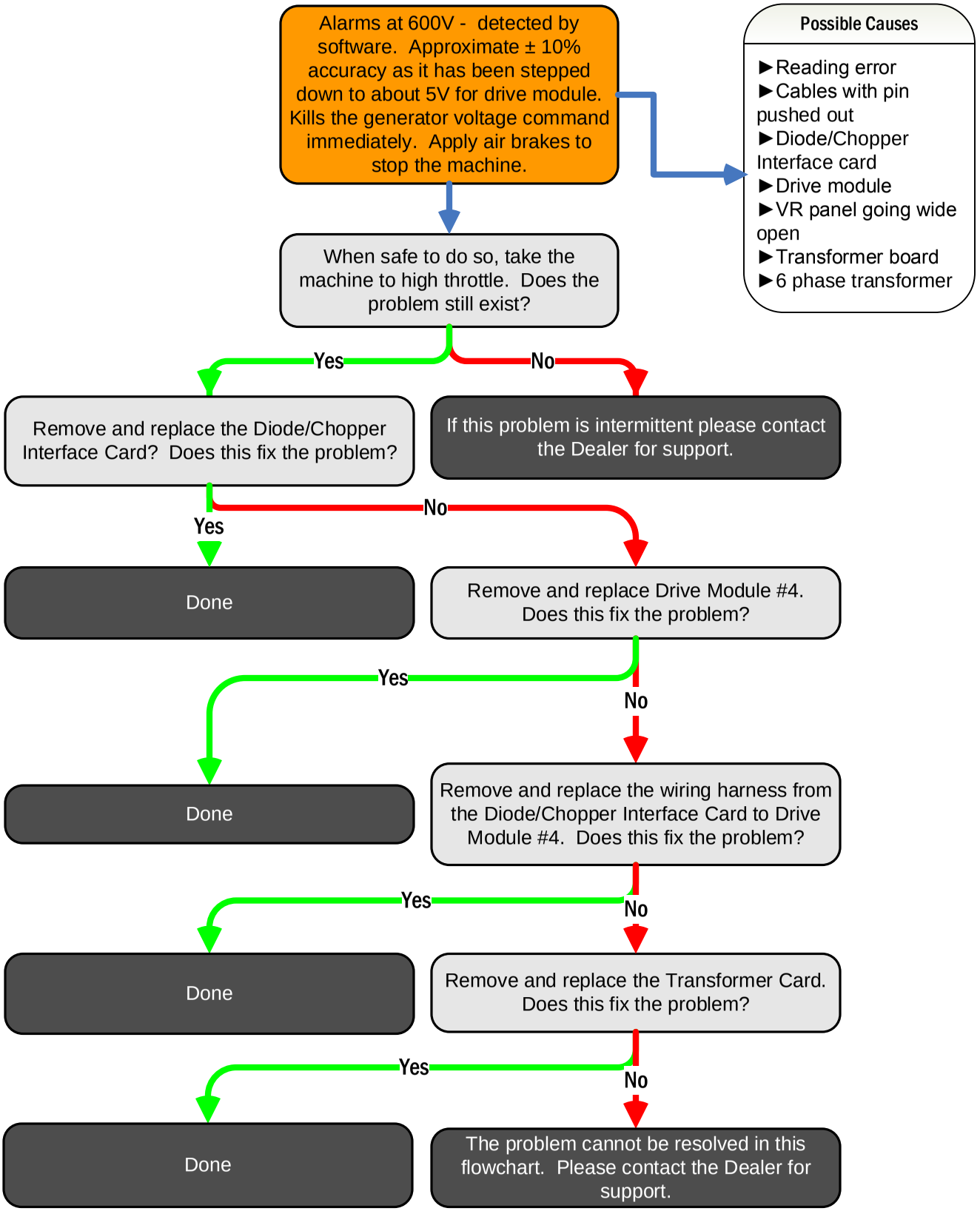
DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
SR DRV **#X** **(X= 1,2,3 OR 4)**	INFORMATION ABOUT DRIVE MODULE	DRIVE MODULE	**SR DRV #X: POWER FAIL**  Red Alarm Light	Module lost power This message might get out at the last minute before power was lost. Typically the drive module will cease to operate at about same time as the alarm so this alarm will be rare.	Drive Module	NO	Reboot	• Defective CAN cable • Defective Drive Module • Defective Configuration	• Reboot and see if clears – if persistent continue with next steps • Install new CAN cable • Replace Drive Module • Replace Master
SR DRV **#X** **(X= 1,2,3 OR 4)**	INFORMATION ABOUT DRIVE MODULE	DRIVE MODULE	**SR DRV #X: NO BROADCASTS**  Amber Warning Light	Master has problem communicating with Drive Module	Drive Module	NO	Reboot	• Defective CAN cable • Defective Drive Module • Defective Master • Defective Configuration	• Reboot and see if clears – if persistent continue with next steps • Replace CAN cable • Repair CAN cable – see KB • Inspect CAN cables inside cab • Replace Drive Module • Replace Master
SR DRV **#X** **(X= 1,2,3 OR 4)**	INFORMATION ABOUT DRIVE MODULE	DRIVE MODULE	**SR DRV #X: DOES NOT RESPOND TO COMMANDS**  Red Alarm Light	Network error Likely will shutdown the entire network – so you may only get this alarm from one module prior to network shutdown. Typically the drive module will cease to operate at about same time as the alarm so this alarm will be rare.	Drive Module	NO	Reboot	• Defective CAN cable • Defective Drive Module • Defective Master • Defective Configuration	• Reboot and see if clears – if persistent continue with next steps • Replace CAN cable • Install a good Restore Point • Replace Drive Module • Replace Master
SR DRV **#X** Module Temperature **(X= 1,2,3 OR 4)**	Internal Drive Module Temperature	DRIVE MODULE	**SR DRV #X: MODULE TEMP LOW**  Amber Warning Light	Temperature is less than -35°C (-31°F)	LINCS	YES	Warm up the Drive Module	• Drive Module cold • Drive Module defective	• Components may not work properly at this temperature • Warm up the electrical cabinet • Check Drive Module temperature with temperature probe and verify that it is actually correct temperature • Replace Interface cards and cables • Replace Drive Module
SR DRV **#X** **(X= 1,2,3 OR 4)**	Internal Drive Module Temperature	DRIVE MODULE	**SR DRV #X: MODULE TEMP CRITICALLY LOW**  Amber Warning Light	Temperature is less than -40°C (-40°F)	LINCS	YES	Warm up the Drive Module	• Drive Module cold • Drive Module defective	• Components may not work properly at this temperature • Warm up the electrical cabinet • Check Drive Module temperature with temperature probe and verify that it is actually correct temperature • Replace Interface cards and cables • Replace Drive Module

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
SR DRV **#X** Module Temperature **(X= 1,2,3 OR 4)**	Internal Drive Module Temperature	DRIVE MODULE	**SR DRV #X: MODULE TEMP HIGH**  Amber Warning Light	Internal temperature drive module is greater than 75°C (167°F) This will begin to cutback on propel and braking	LINCS	YES	Cool down the Drive Module	• Drive Module hot • Drive Module defective	**WARNING:** **Stop machine immediately as this will cut back on propel and braking** • Check Drive Module temperature with temperature probe and determine reason for temperature • Replace Interface cards and cables • Replace Drive Module
SR DRV **#X** Module Temperature **(X= 1,2,3 OR 4)**	Internal Drive Module Temperature	DRIVE MODULE	**SR DRV #X: MODULE TEMP CRITICALLY HIGH**  Amber Warning Light	Internal temperature drive module is greater than 80°C (176°F) This will eliminate propel and braking for that drive module.	LINCS	YES	Cool down the Drive Module	• Drive Module hot • Drive Module defective	**WARNING:** **Stop machine immediately as this will eliminate propel and braking on the drive module.** • Check Drive Module temperature with temperature probe and determine reason for temperature • Replace Interface cards and cables • Replace Drive Module
Torque Limit Cmd	Variable 0-100% maximum range 0-72% on L-950 0-80% on D-950 0-80% on L-950	Drive Motor Channel	**- NO ALARM -**	LINCS Drive control limits Separate command used for limiting torque. Reduces torque based on temperature input, speed curve for braking/propel, selectable limits	NO	N\A	N\A	N\A	N\A
Vehicle Speed	Filtered average speed of 4 motors which has been converted to miles per hour	LINCS	**Vehicle Speed Out of Control – Use Brakes!**  Amber Warning Light	Vehicle is going too fast. 950 > 16.6 mph (4980 rpm) for .500 seconds 1350 > 11 mph (3750 rpm) for .500 seconds A hint screen is also provided that says “Apply Service Brakes”	LINCS	When speed has reduced. 950 < 14 mph (4200 rpm) for .500 seconds 1350 < 10 mph (3500 rpm) for .500 seconds	Reduce speed	• Braking grids hot • Grade too steep - going faster than grade chart allows • Generator has shut off so no retarding.	• Apply brakes immediately and slow machine down. • Radiator fan not going to high speed in retard mode • Slow down • Follow the speed/grade limits on the grade chart in the cab. • Correct problem with generator
VR Fuse Status	0 = OK 10,000 = blown (Active only on Drive Module 4)	VR	**SR DRV #4: VR Fuse Status: Blown**  Amber Warning Light	Indicates one or more blown fuse(s) One signal to monitor all 3 VR fuses. 3 individual fuses monitored but only one alarm	VR Interface Card. Compares voltage difference across fuses. Normally 0 difference	When the open fuse has been replaced	Replace fuse	• Check fuses on VR panel • Check cables for continuity • Check connectors for pushed out pin. • Interface card • VR interface card • Drive Module	• Check fuses with meter. • Replace fuse(s) • Inspect/replace cables • Replace VR interface card • Replace VR panel • Replace interface card • Replace Drive Module

DRIVE SYSTEM AND SR CHANNELS			DRIVE SYSTEM AND SR RELATED WARNINGS, ALARMS AND MESSAGES						
Channel	**Description**	**Area of Drive System**	**Warning/Alarm/Message**	**Description of Warning/Alarm**	**Warning/Alarm/ Message generated from?**	**Does signal reset?**	**How to reset?**	**Possible Causes**	**Recommended Action**
VR Heatsink Temp	Thermistor temp on the VR heatsink Cutback on all 4 wheel motors at same time – expcept in braking (Active only on Drive Module 4)	VR	**SR DRV #4: VR Heatsink Temp: High Converters Cutting Back**  Amber Warning Light	Thermistor voltage on VR heatsink (0-10V signal) Cutback starts 85°C and gives first alarm of temperature high Converter completely off at 90°C and gives second alarm of temperature critically high	Configuration Software	Yes	When temperature cools down to 80°C	• Airflow • Thermistor • Wiring • Interface card • Drive module	• Check airflow • Check thermistor resistance • Check wiring to interface card • Check wiring to Drive Module – look for pins pushed out • Replace VR interface card • Replace Drive Module • Replace VR panel
VR Heatsink Temp	Thermistor temp on the VR heatsink Cutback on all 4 wheel motors at same time – expcept in braking (Active only on Drive Module 4)	VR	**SR DRV #4: VR Heatsink Temp: Critically High Converters Cut Off**  Amber Warning Light	Thermistor voltage on VR heatsink (0-10V signal) Cutback starts 85°C and gives first alarm of temperature high Converter completely off at 90°C and gives second alarm of temperature critically high	Configuration Software	Yes	When temperature cools down to 80°C	• Airflow • Thermistor • Wiring • Interface card • Drive module	• Check airflow • Check thermistor resistance • Check wiring to interface card • Check wiring to Drive Module – look for pins pushed out • Replace VR interface card • Replace Drive Module • Replace VR panel

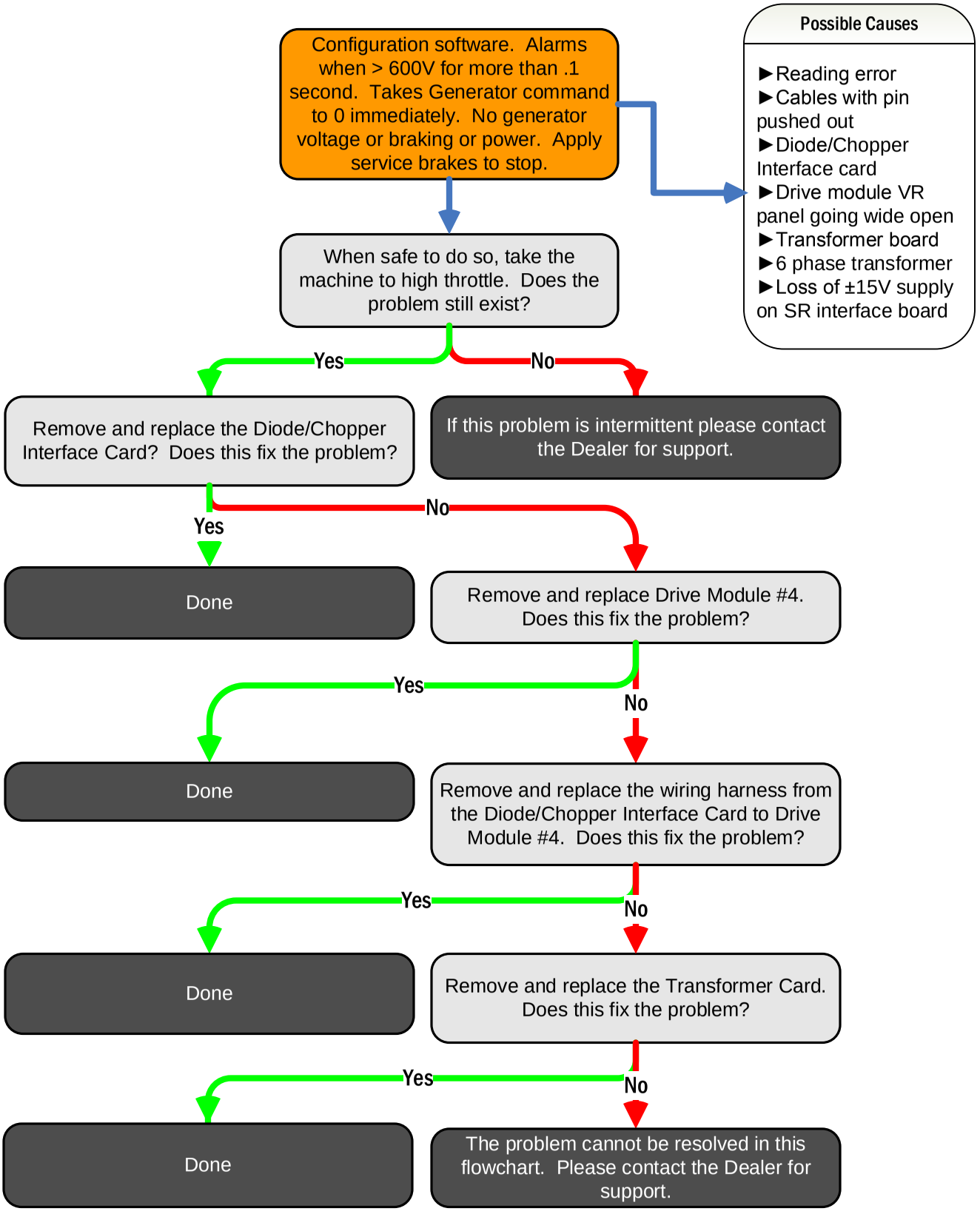
AC Supply Voltage High

Electrical Symptom	8/30/2009	Page 1 of 1



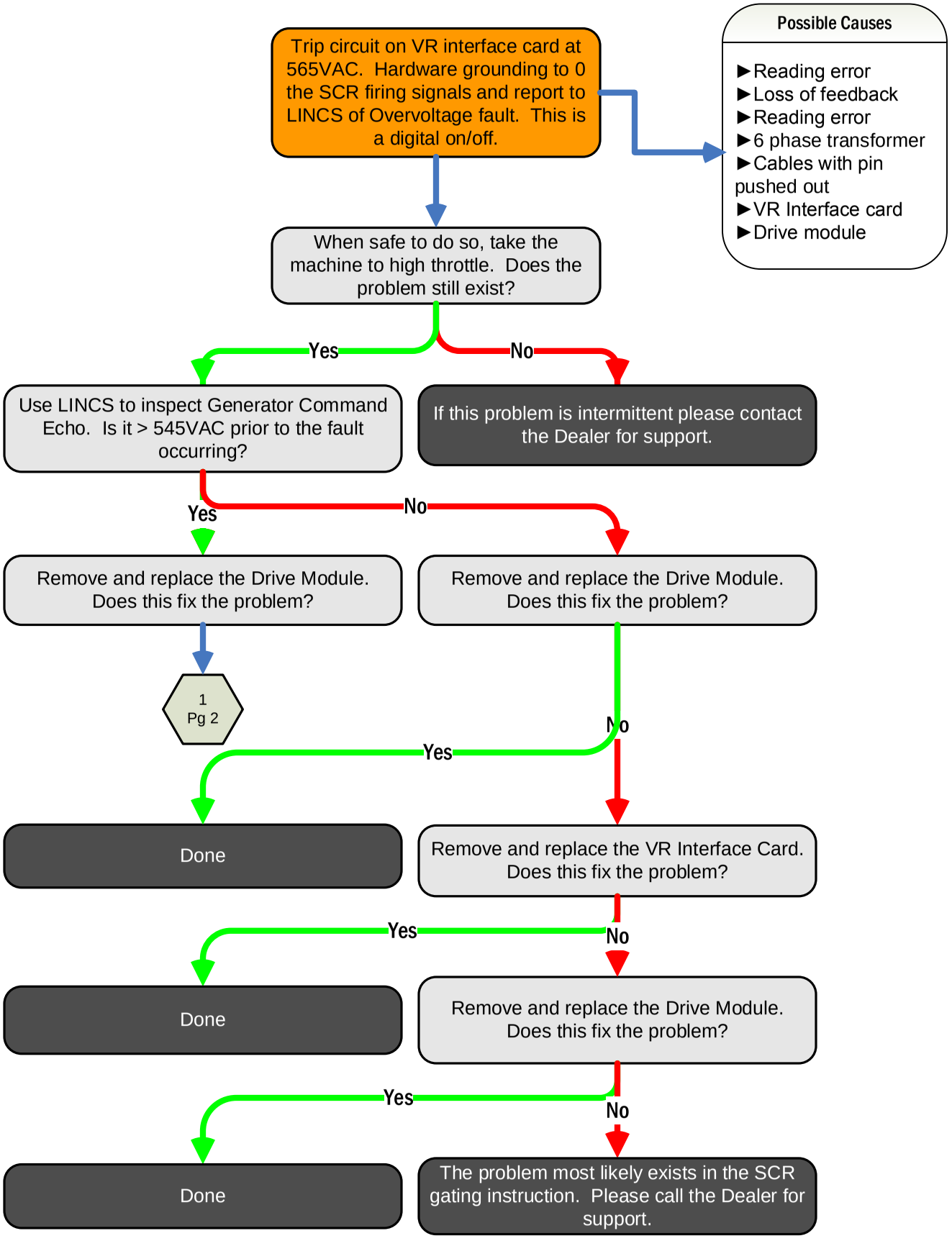
AC Overvoltage High (Software Driven)

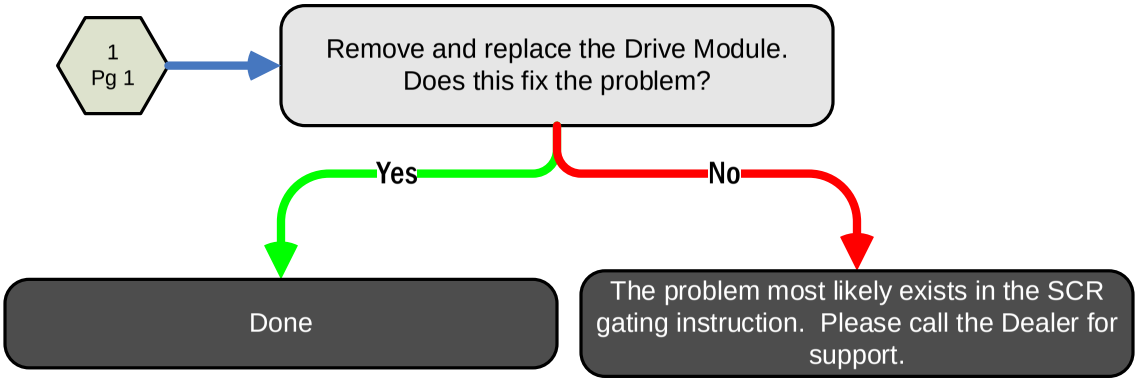
Electrical Symptom	8/30/2009	Page 1 of 1



AC Overvoltage Fault (Hardware Driven)

Electrical Symptom	8/30/2009	Page 1 of 1




1
Pg 1
Remove and replace the Drive Module.
Does this fix the problem?
Yes
No
Done
The problem most likely exists in the SCR gating instruction. Please call the Dealer for support.

AC Fuse Blown

Electrical Symptom	8/30/2009	Page 1 of 2

A, B or C phase fuse blown. Machine continues to run on the other fuses. The bus voltage will droop under full load. Warning message only. No effect on operation other than drooping bus.

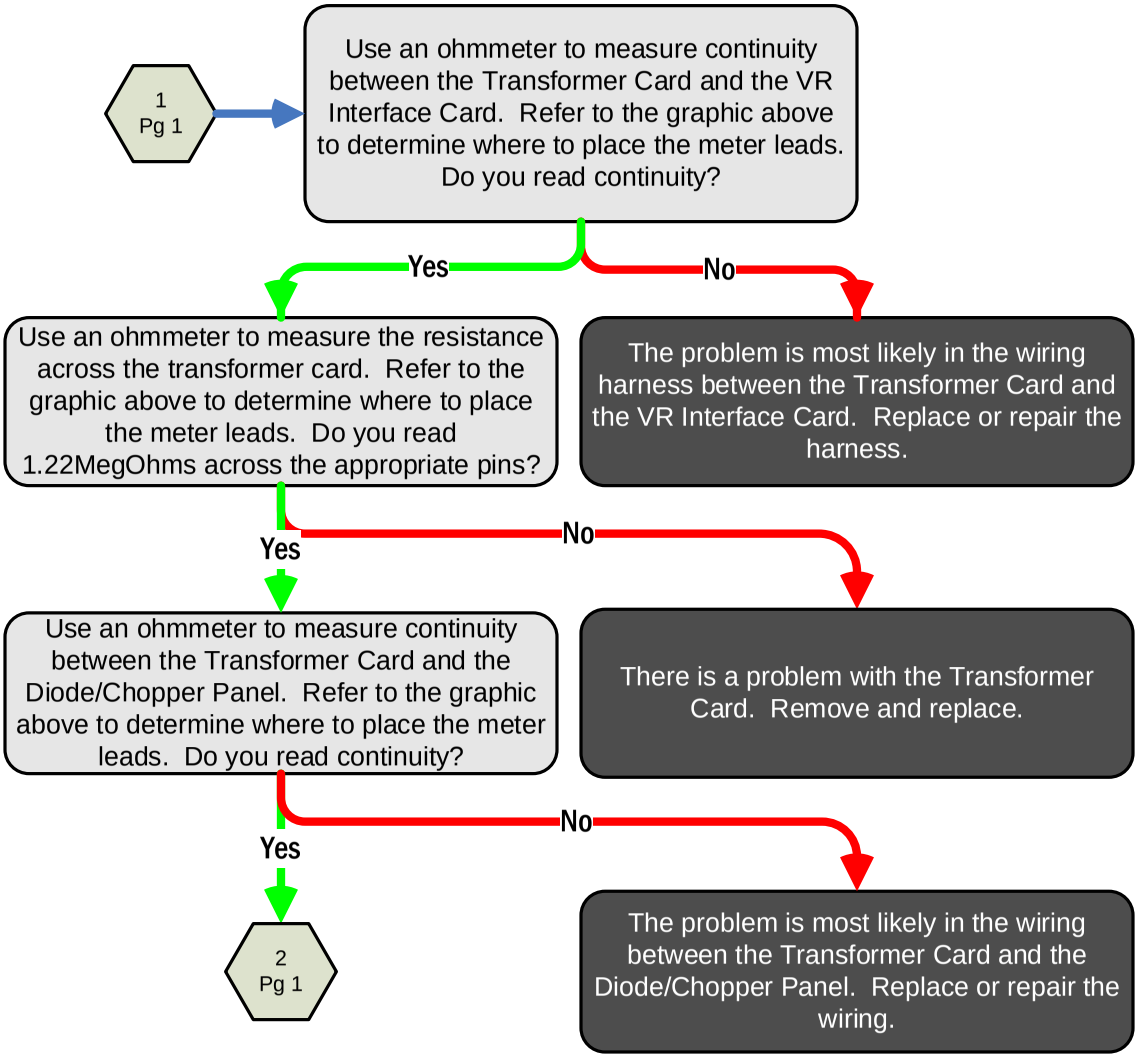
Possible Causes

- ►Defective Diode/ Chopper interface card
- ►Defective Diode/ Chopper interface card
- ►Loose wire or pin – pull up circuit in Drive Module.
- ►Transformer card
- ►Drive Module
- ►Loss of 24V power to packages or panels

Are other alarms active?

- Yes → Fix the other alarms first.
- No → Remove the fuse. Use an ohmmeter to verify that the fuse is NOT blown. Is the fuse good?
  - Yes → Re-install the fuse to its original location. At the VR Interface Card, use an ohmmeter to measure the resistance across the following points: Conn 9, Pins 1 & 2 = A; Conn 9, Pins 3 & 4 = B, Conn 9, Pins 5 & 6 = C. Do you read 2.2MegOhms across the appropriate pins?
    - Yes → Install I/O Breakout Box [425-5739] in-line between Drive Module #4 and Drive Module I/O Connector. Refer to schematic for Drive Module I/O Connector, and Channel number. Measure continuity between the VR Interface Card and the Drive Module. Do you read continuity?
      - Yes → Remove and replace the Drive Module. Does this fix the problem?
        - Yes → Done
        - No → Remove and replace the VR Interface Card. Does this fix the problem?
          - Yes → Done
          - No → The problem cannot be resolved in this flowchart. Please contact the Dealer for support.
      - No → The problem is most likely in the wiring harness between the VR Interface Card and Drive Module #4. Replace or repair the harness.
    - No → Use an ohmmeter to measure continuity between the Transformer Card and the VR Interface Card. Refer to the graphic above to determine where to place the meter leads. Do you read continuity?
      - → 1 Pg 2
  - No → Remove and replace the fuse. If the problem continues contact the Dealer for support.

2 Pg 2 →


1
Pg 1
Use an ohmmeter to measure continuity between the Transformer Card and the VR Interface Card. Refer to the graphic above to determine where to place the meter leads. Do you read continuity?
Yes
No
Use an ohmmeter to measure the resistance across the transformer card. Refer to the graphic above to determine where to place the meter leads. Do you read 1.22MegOhms across the appropriate pins?
The problem is most likely in the wiring harness between the Transformer Card and the VR Interface Card. Replace or repair the harness.
Yes
No
Use an ohmmeter to measure continuity between the Transformer Card and the Diode/Chopper Panel. Refer to the graphic above to determine where to place the meter leads. Do you read continuity?
There is a problem with the Transformer Card. Remove and replace.
Yes
No
2
Pg 1
The problem is most likely in the wiring between the Transformer Card and the Diode/Chopper Panel. Replace or repair the wiring.

Chopper Temp High

Electrical Symptom	9/9/2009	Page 1 of 2

0-10V analog signal from the Semikron and Powerex packages. 0-120°C. Cutback starts 85°C and gives first alarm of temperature high. Converters completely off at 90°C and gives second alarm of temperature critically high

Possible Causes

- ►Airflow missing or reduced
- ►Temperature device problem
- ►Interface card problem (Diode/Chopper) interface
- ►Drive Module Problem
- ►Cable problem

Are more than 1 Chopper/Phase temp alarms active?

Yes

The most likely problem is a lack of adequate air flow to provide cooling to the Generator. Refer to the Blower Speed Adjustment located under Procedures> Adjustments> Blower Circuit>.

No

Use LINCS to examine the appropriate Temperature channel for the affected Chopper Panel. Is it > 85°C or 185°F?

Yes

Use a Temperature Sensing Tool and examine the reported panel located in the SR Cabinet. Compare the real temperature to the other panels. Is it significantly hotter than the others?

No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

Yes

Use an ohmmeter to check grid resistance. Do you measure X ohms? X = 1.82Ω [L1350], 2.38Ω [L950 with older style grids], 1.62Ω [L950 with upgraded grids]

No

Install the IGBT Test Kit [425-4113]. Use and ohmmeter to measure continuity from Pin 12 on the test kit to the Diode/Chopper Interface Card, Conn 4, Pin 12. Do you read continuity?

1 Pg 2

Yes

Remove and replace the affected Chopper Panel. Does this fix the problem?

No

Remove and replace the grid for the affected chopper panel. Does this fix the problem?

Yes

Done

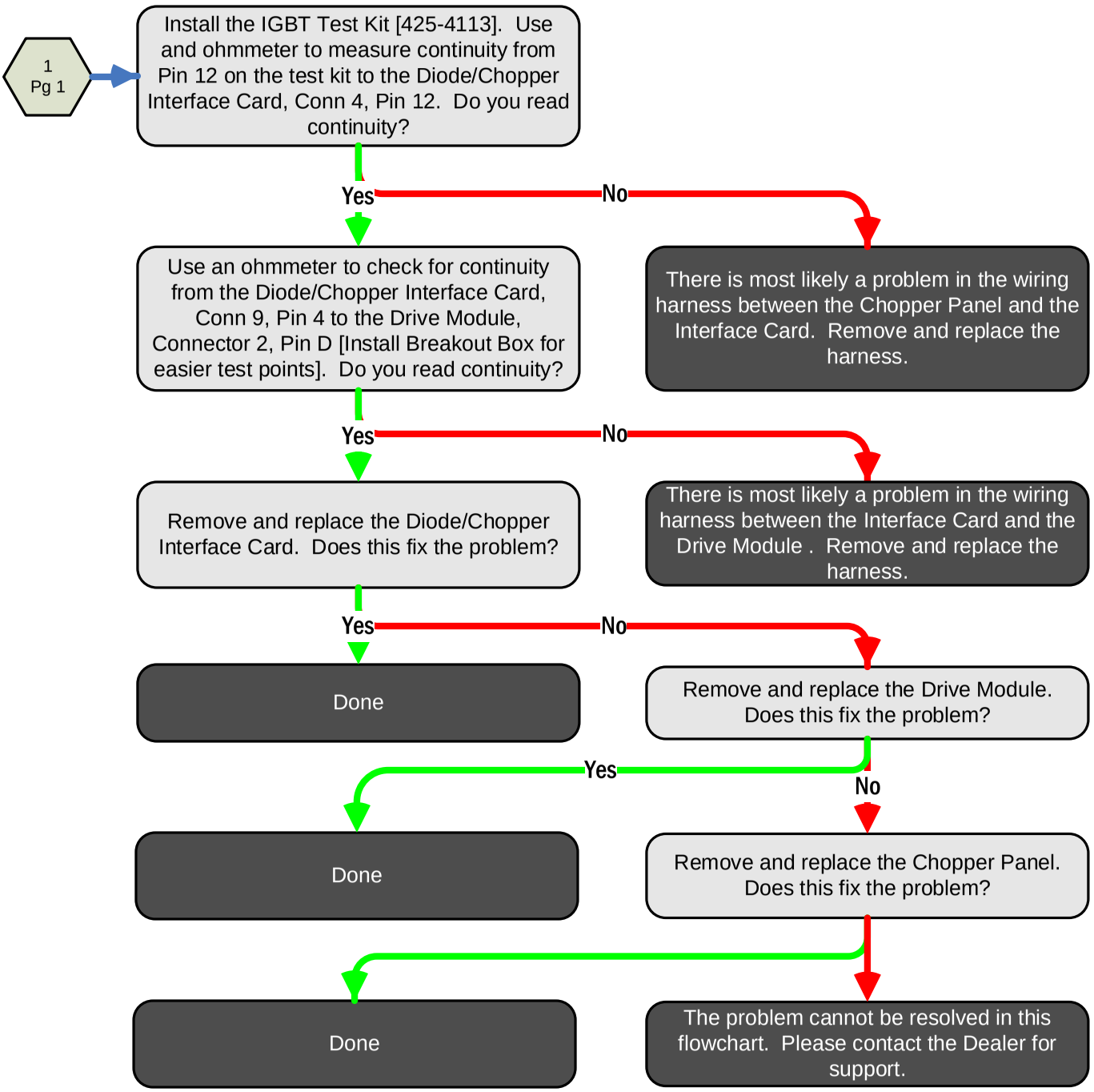
No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

No

Yes

Done


1
Pg 1
Install the IGBT Test Kit [425-4113]. Use and ohmmeter to measure continuity from Pin 12 on the test kit to the Diode/Chopper Interface Card, Conn 4, Pin 12. Do you read continuity?
Yes
No
There is most likely a problem in the wiring harness between the Chopper Panel and the Interface Card. Remove and replace the harness.
Use an ohmmeter to check for continuity from the Diode/Chopper Interface Card, Conn 9, Pin 4 to the Drive Module, Connector 2, Pin D [Install Breakout Box for easier test points]. Do you read continuity?
Yes
No
There is most likely a problem in the wiring harness between the Interface Card and the Drive Module . Remove and replace the harness.
Remove and replace the Diode/Chopper Interface Card. Does this fix the problem?
Yes
No
Done
Remove and replace the Drive Module. Does this fix the problem?
Yes
No
Done
Remove and replace the Chopper Panel. Does this fix the problem?
Done
The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

Chopper Temp Critically High

Electrical Symptom	9/9/2009	Page 1 of 2

0-10V analog signal from the Semikron and Powerex packages. 0-120°C. Cutback starts 85°C and gives first alarm of temperature high. Converters completely off at 90°C and gives second alarm of temperature critically high

Possible Causes

- ►Airflow missing or reduced
- ►Temperature device problem
- ►Interface card problem (Diode/Chopper) interface
- ►Drive Module Problem
- ►Cable problem

Are more than 1 Chopper/Phase temp alarms active?

Yes

The most likely problem is a lack of adequate air flow to provide cooling to the Generator. Refer to the Blower Speed Adjustment located under Procedures> Adjustments> Blower Circuit>.

No

Use LINCS to examine the appropriate Temperature channel for the affected Chopper Panel. Is it > 85°C or 185°F?

Yes

Use a Temperature Sensing Tool and examine the reported panel located in the SR Cabinet. Compare the real temperature to the other panels. Is it significantly hotter than the others?

No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

Yes

Use an ohmmeter to check grid resistance. Do you measure X ohms? X = 1.82Ω [L1350], 2.38Ω [L950 with older style grids], 1.62Ω [L950 with upgraded grids]

No

Install the IGBT Test Kit [425-4113]. Use and ohmmeter to measure continuity from Pin 12 on the test kit to the Diode/Chopper Interface Card, Conn 4, Pin 12. Do you read continuity?

1 Pg 2

Yes

Remove and replace the affected Chopper Panel. Does this fix the problem?

No

Remove and replace the grid for the affected chopper panel. Does this fix the problem?

Yes

Done

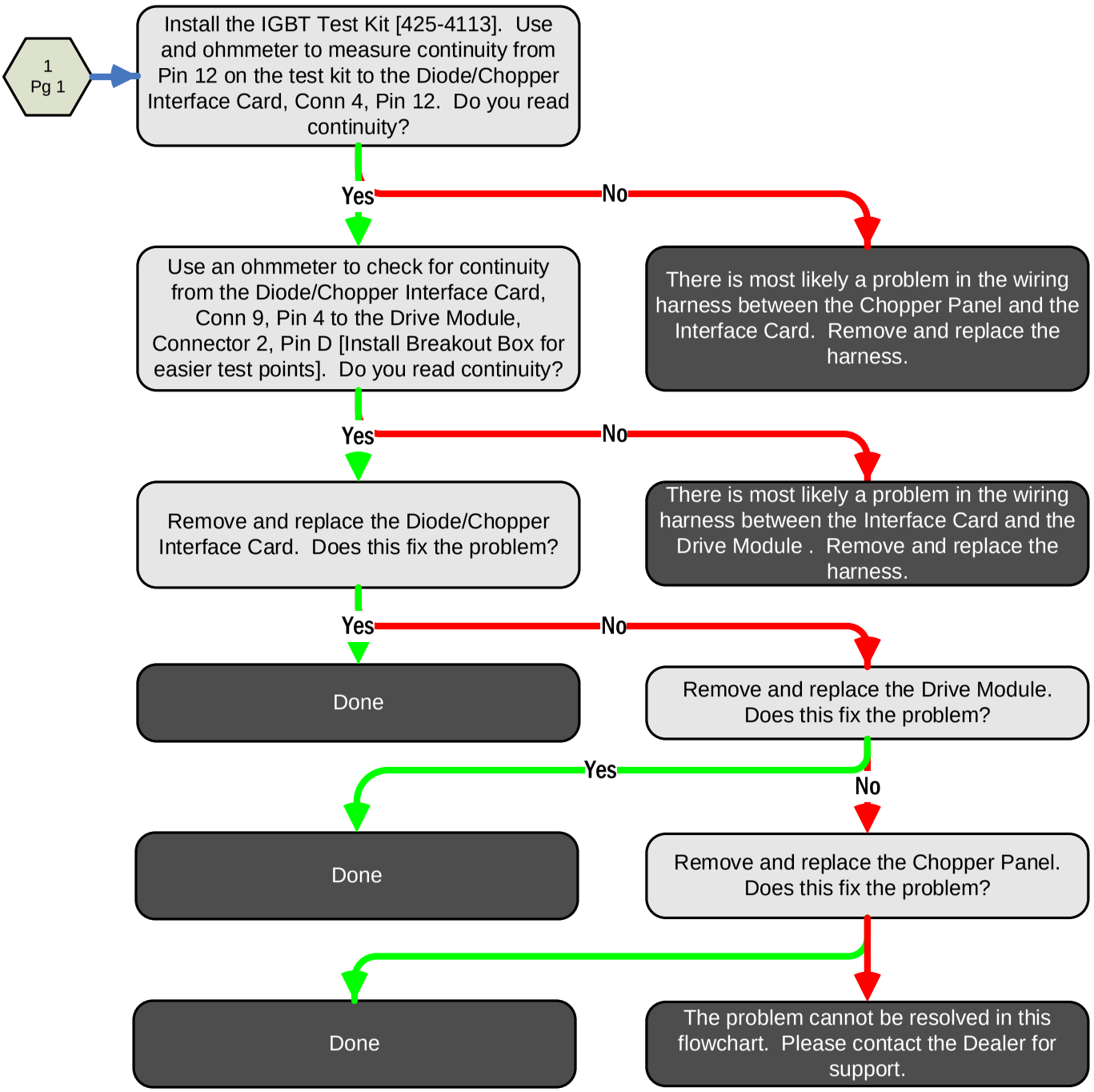
No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

No

Yes

Done


1
Pg 1
Install the IGBT Test Kit [425-4113]. Use and ohmmeter to measure continuity from Pin 12 on the test kit to the Diode/Chopper Interface Card, Conn 4, Pin 12. Do you read continuity?
Yes
No
There is most likely a problem in the wiring harness between the Chopper Panel and the Interface Card. Remove and replace the harness.
Use an ohmmeter to check for continuity from the Diode/Chopper Interface Card, Conn 9, Pin 4 to the Drive Module, Connector 2, Pin D [Install Breakout Box for easier test points]. Do you read continuity?
Yes
No
There is most likely a problem in the wiring harness between the Interface Card and the Drive Module . Remove and replace the harness.
Remove and replace the Diode/Chopper Interface Card. Does this fix the problem?
Yes
No
Done
Remove and replace the Drive Module. Does this fix the problem?
Yes
No
Done
Remove and replace the Chopper Panel. Does this fix the problem?
Done
The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

Chopper Status Fault

Electrical Symptom	8/30/2009	Page 1 of 1

Analog signal on the Powerex and Semikron IGBT module. Determined by internal circuitry on the Powerex or Semikron driver card. Normally accompanied by red light(s) on Powerex panel (unless it is a loose pin problem). If switch is bad – braking for that motor is lost

Possible Causes

- ►Red LED lit on panel
- ►Bad IGBT or driver board
- ►Open wire from IGBT board to interface card to DM
- ►Bad diode chopper interface card
- ►Bad cable to chopper
- ►Bad SR interface card
- ►Bad cable between SR interface and diode chopper interface card
- ►Lack of 24V supply to the SR interface card – this will typically give a status fault warning on all phases and chopper.
- ►Bad switch or driver board

Are other alarms active?

Yes → Fix those problems first.

No → With LINCS booted, look at the Chopper Panel indicated in the fault. Are all of the green lights on?

Yes → With LINCS booted, look at the Chopper Panel indicated in the fault. Are any of the red lights on?

No → There is an internal problem with the Chopper Panel. Remove and replace.

Yes → There is an internal problem with the Chopper Panel. Remove and replace

No → Install the SR/Chopper Panel Breakout Module (425-4113). Use an ohmmeter to measure continuity between the affected Chopper Panel [Breakout Pin X] and the affected Diode/Chopper Interface Card [Conn 4, Pin 3]. Do you read continuity?

Yes → Install I/O Breakout Box [425-5739] in-line between the affected Drive Module and Drive Module I/O Connector. Refer to schematic for Drive Module I/O Connector, and Channel number. Measure continuity between the Diode/Chopper Interface Card [Conn 11, Pin 1] and the Drive Module [Conn 4, Pin 1]. Do you read continuity?

No → The problem is most likely in the wiring harness between the Chopper Panel and the Diode/Chopper Interface Card. Remove and replace

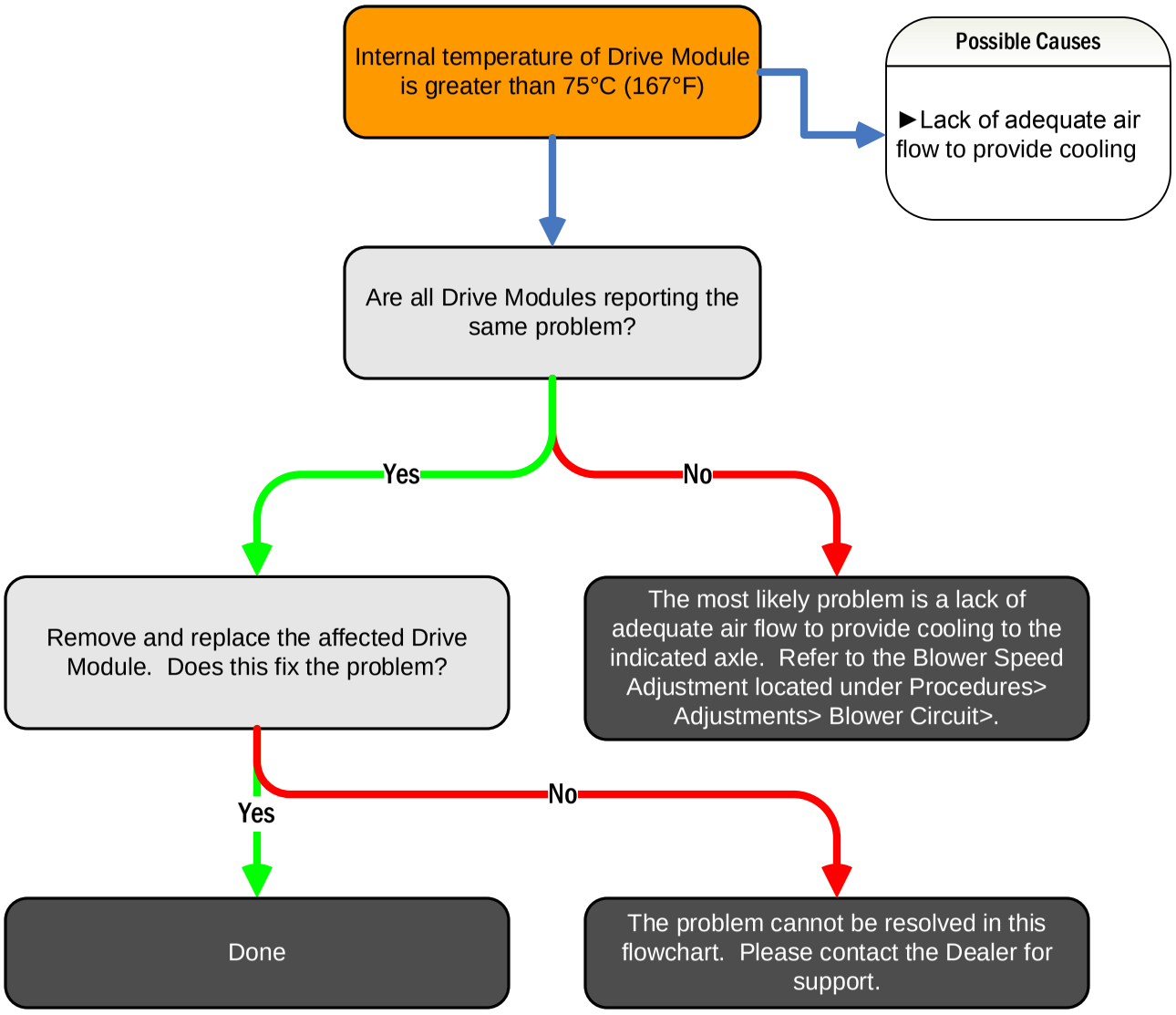
Yes → Remove and replace the affected Drive Module. Does this fix the problem?

No → The problem is most likely in the wiring harness between the Diode/Chopper Interface Card and the Drive Module. Remove and replace

Yes → Done

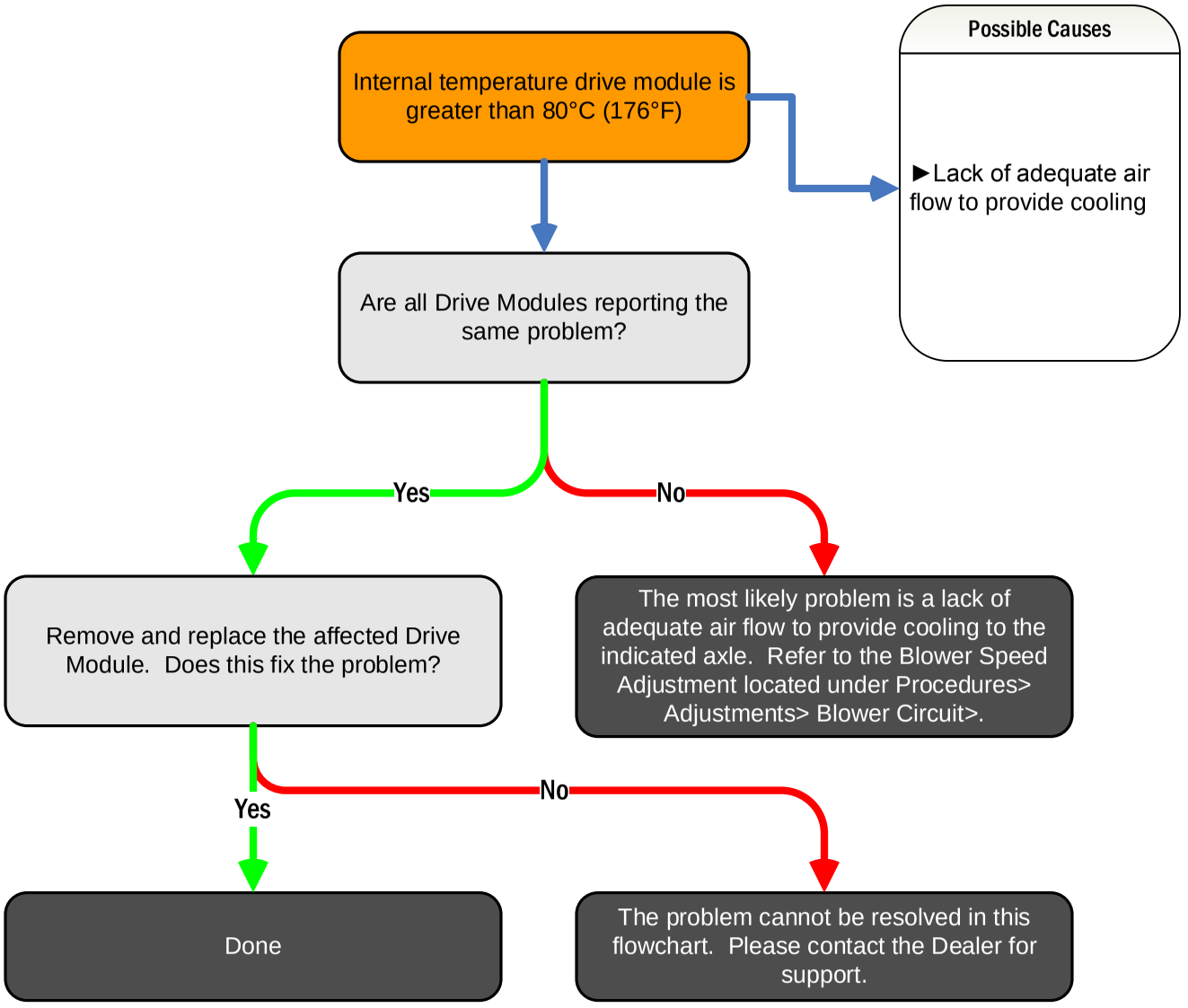
No → The problem cannot be resolved in this flowchart. Please call the Dealer for support.

Drive Module Temperature High		
Electrical Symptom	8/30/2009	Page 1 of 1

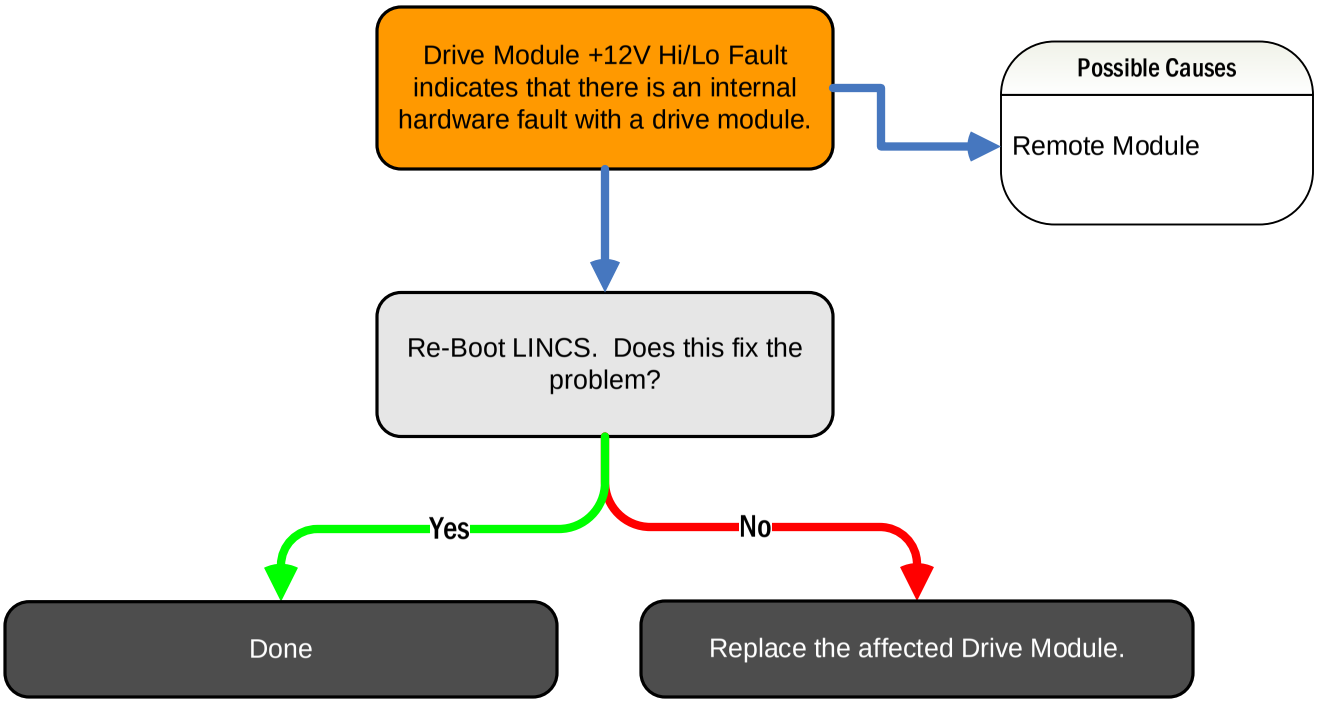


Drive Module Temperature Critically High

Electrical Symptom	8/30/2009	Page 1 of 1

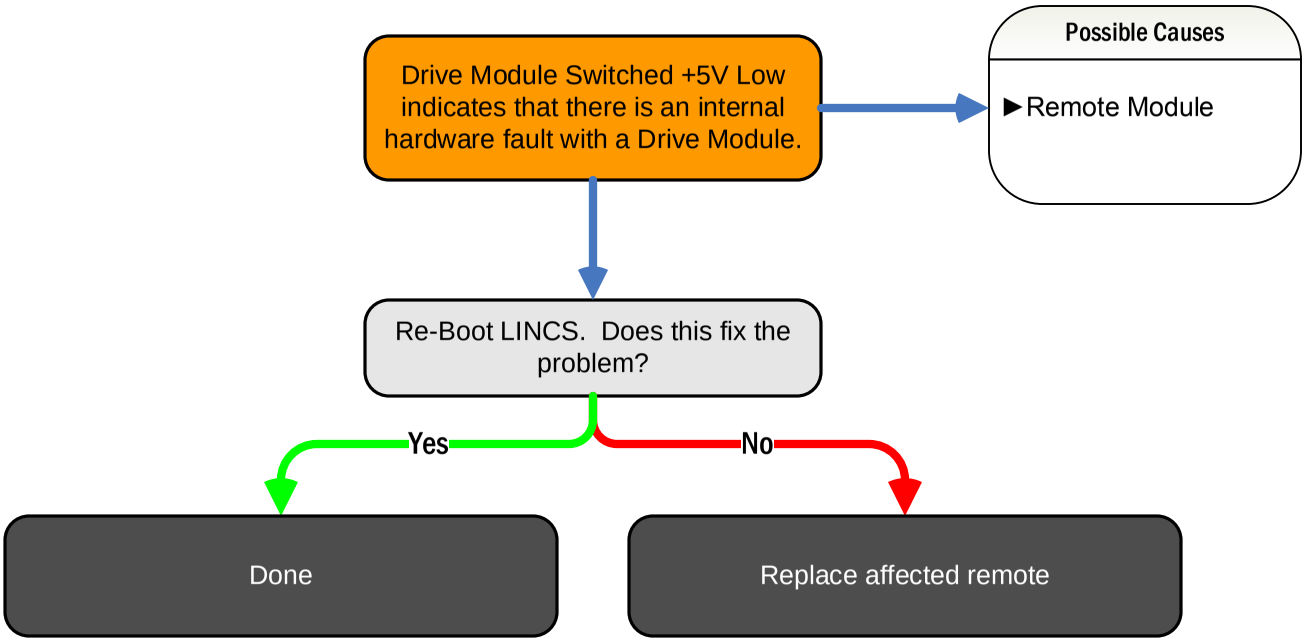


Drive Module +12V Hi/Lo Fault		
Electrical Symptom	8/30/2009	Page 1 of 1

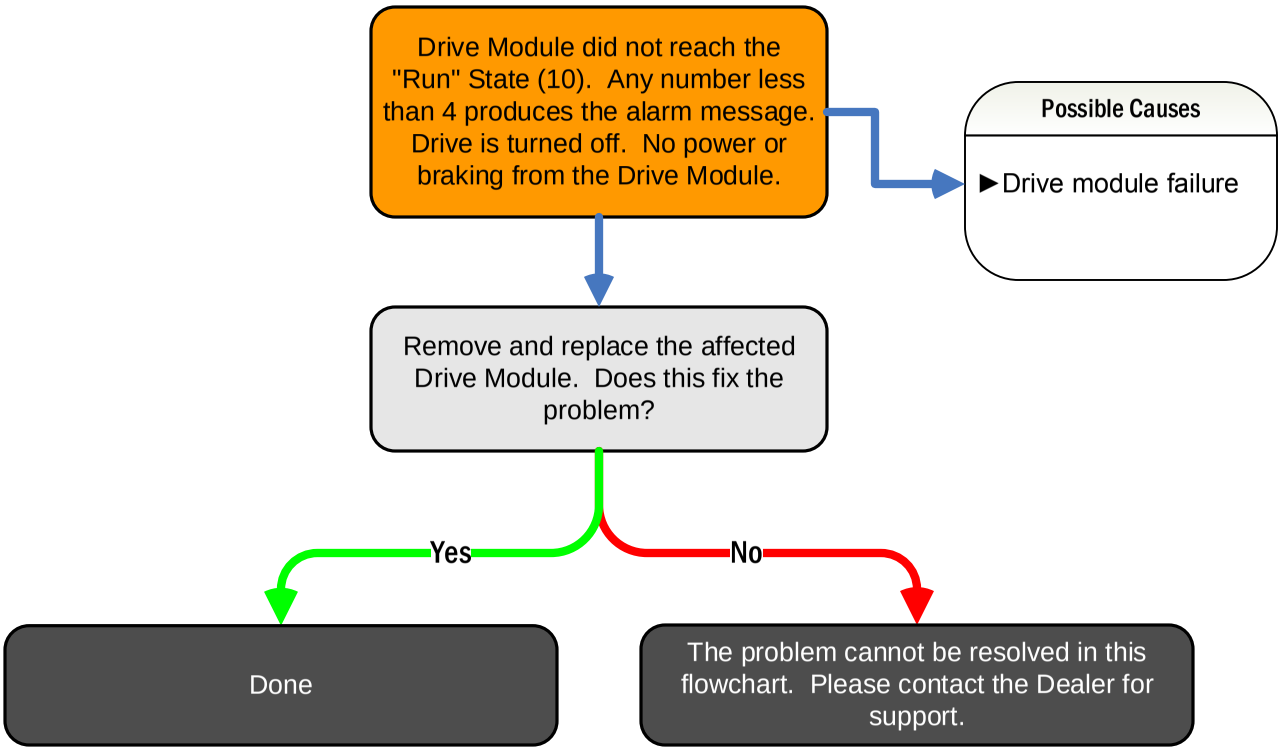


Drive Module Switched +5V Low

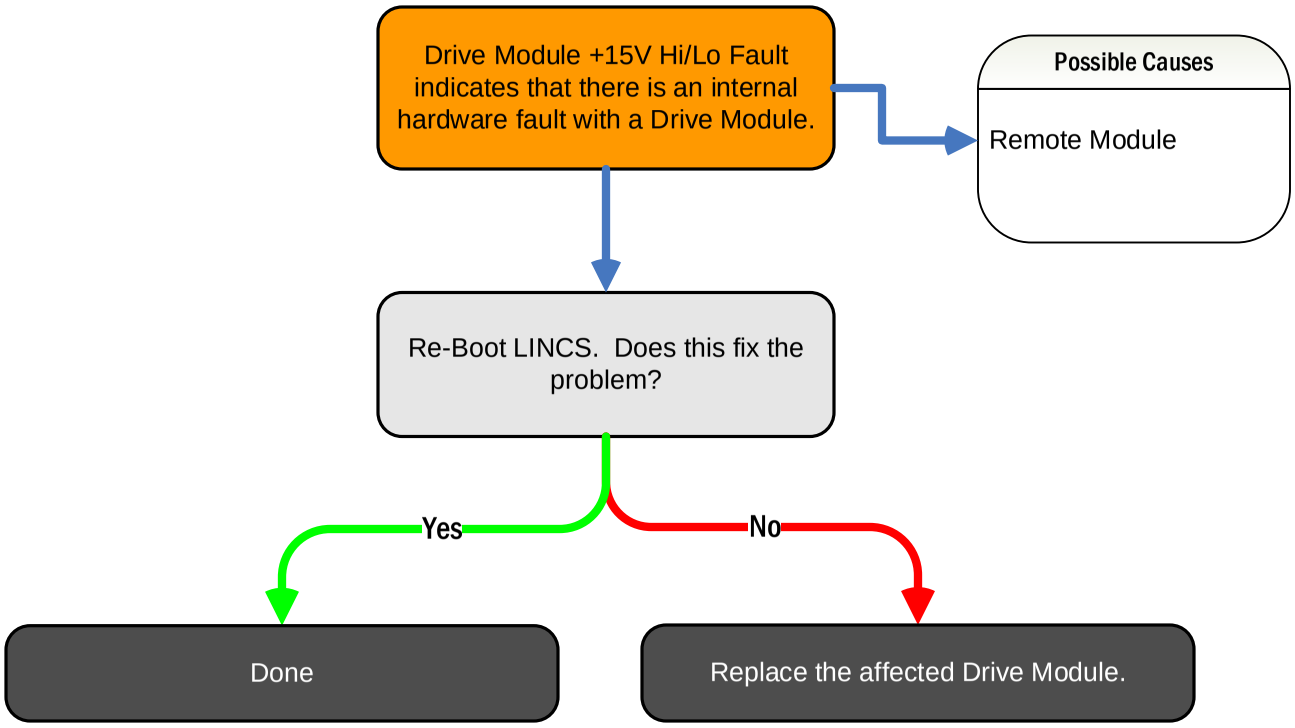
Electrical Symptom	8/26/2009	Page 1 of 1



Drive State Fault		
Electrical Symptom	8/30/2009	Page 1 of 1

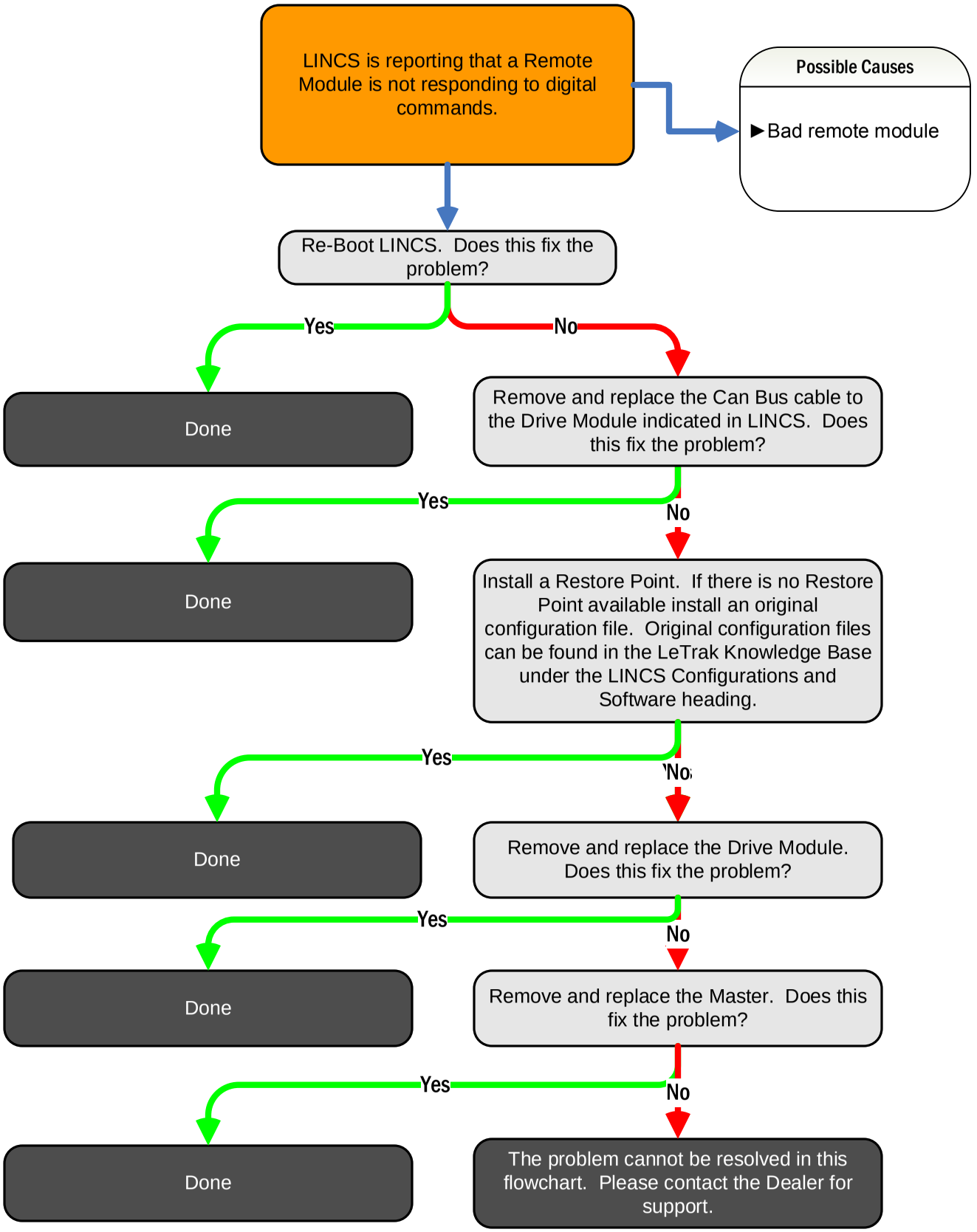


Drive Module +15V Hi/Lo Fault		
Electrical Symptom	8/30/2009	Page 1 of 1

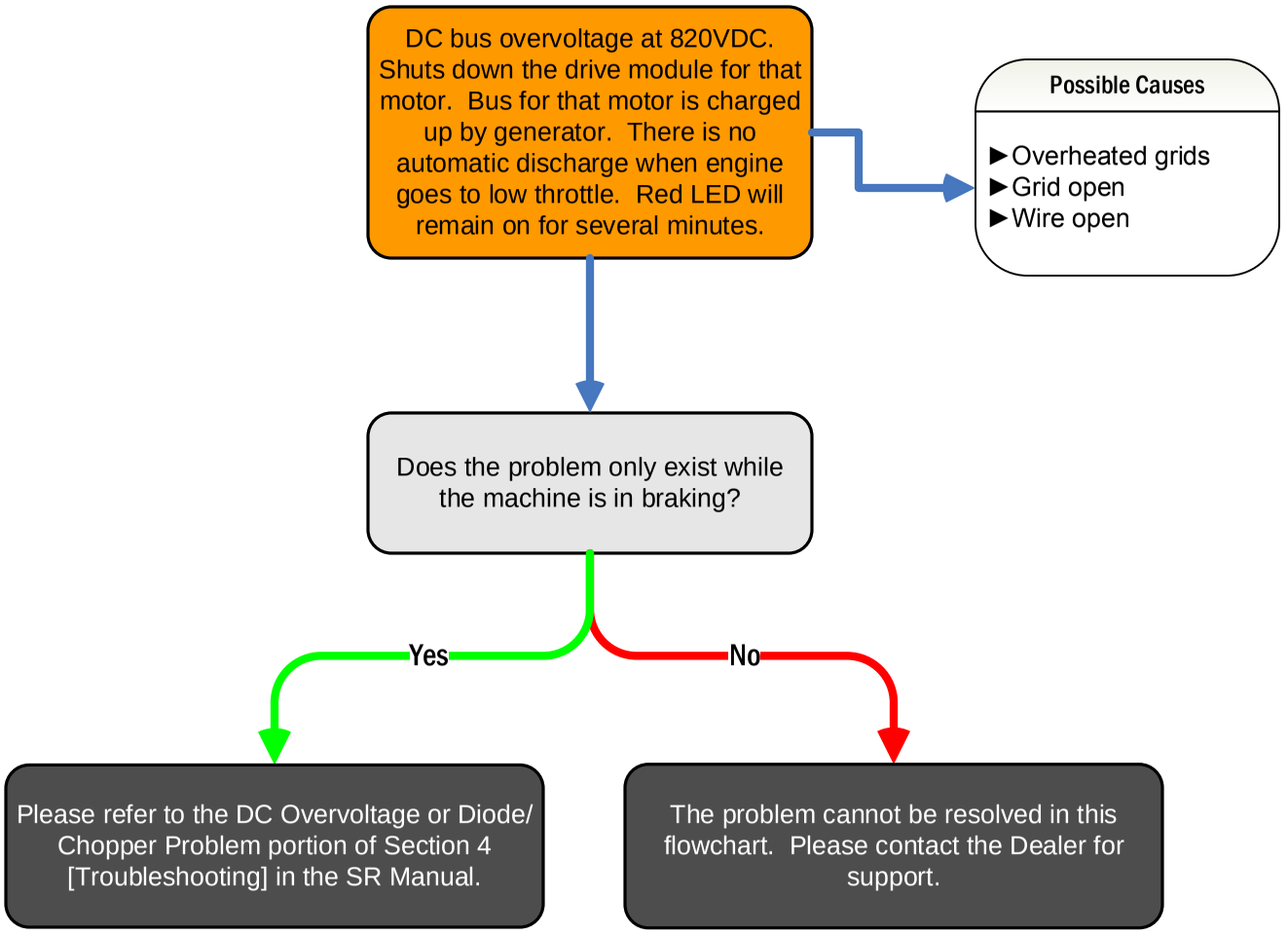


Does Not Respond to Commands

Electrical Symptom	8/30/2009	Page 1 of 1

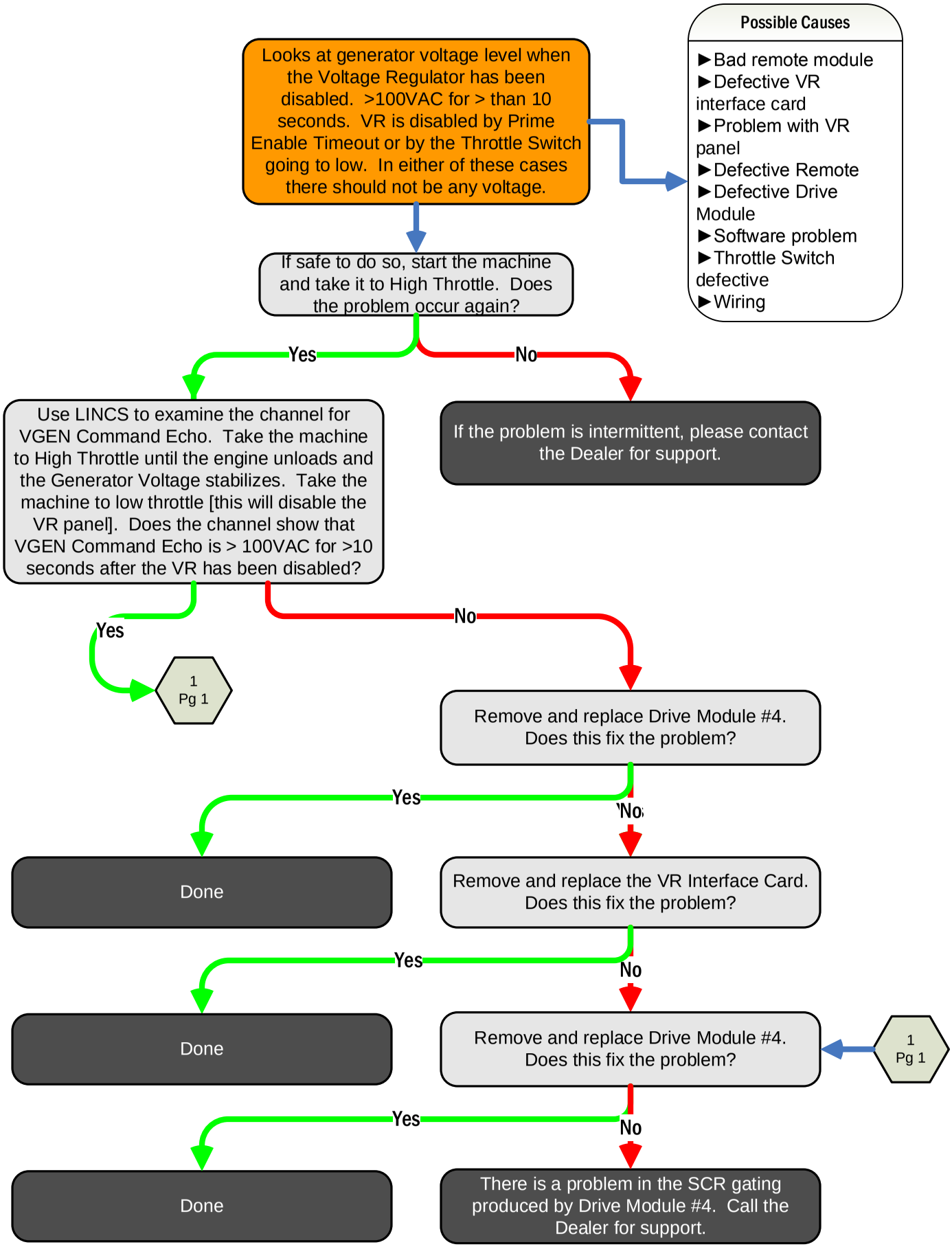


DC Bus Voltage High (DC Overvoltage)		
Electrical Symptom	8/30/2009	Page 1 of 1



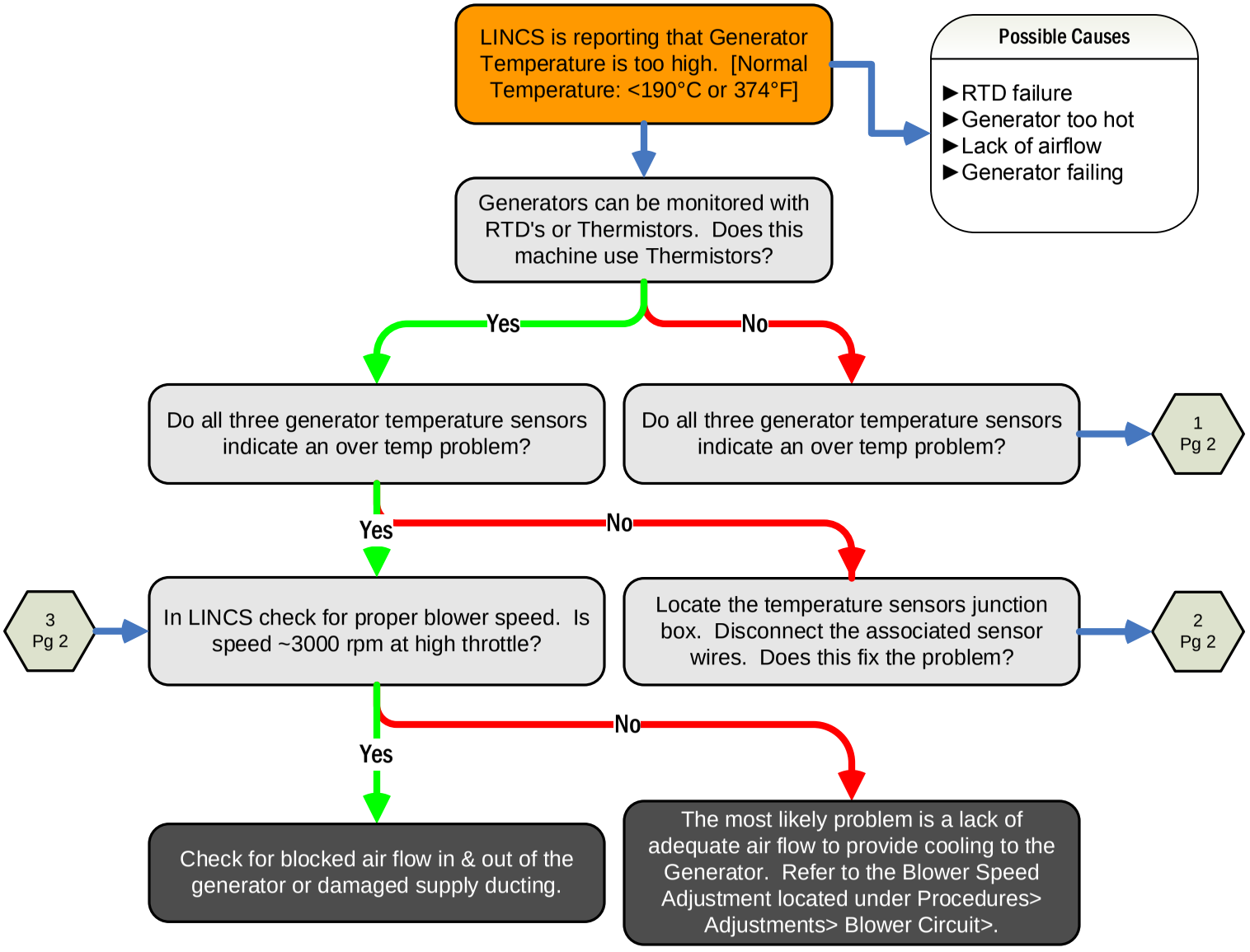
Generator Voltage Fault

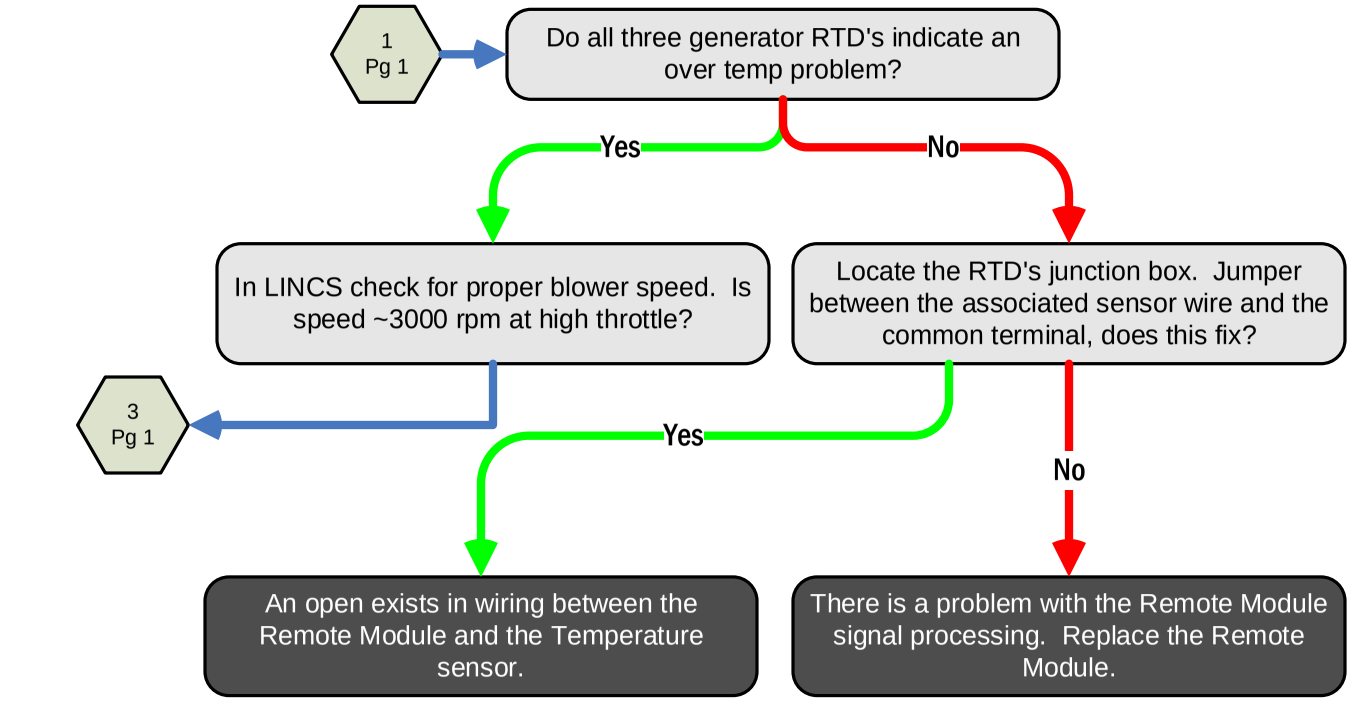
Electrical Symptom	8/30/2009	Page 1 of 1

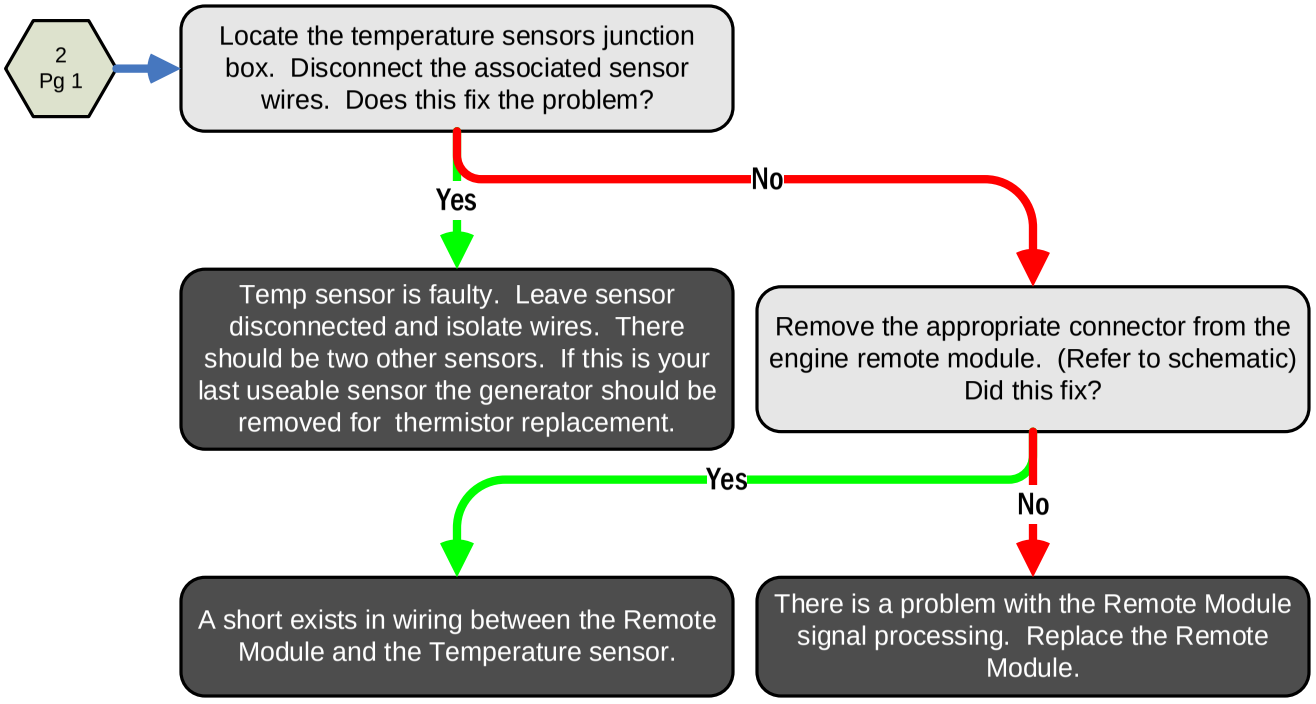


Generator Temperature High

Electrical Symptom	8/30/2009	Page 1 of 2

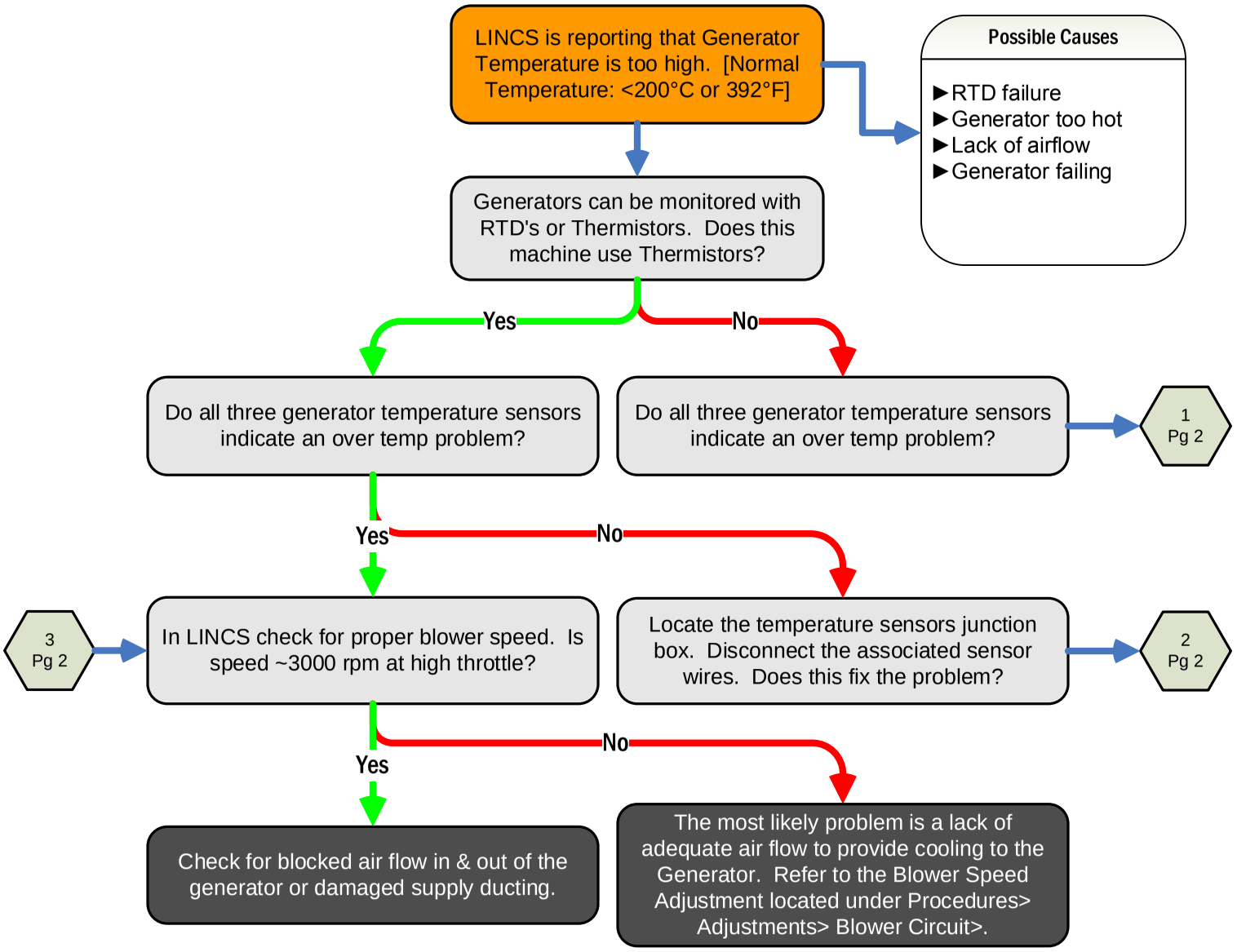


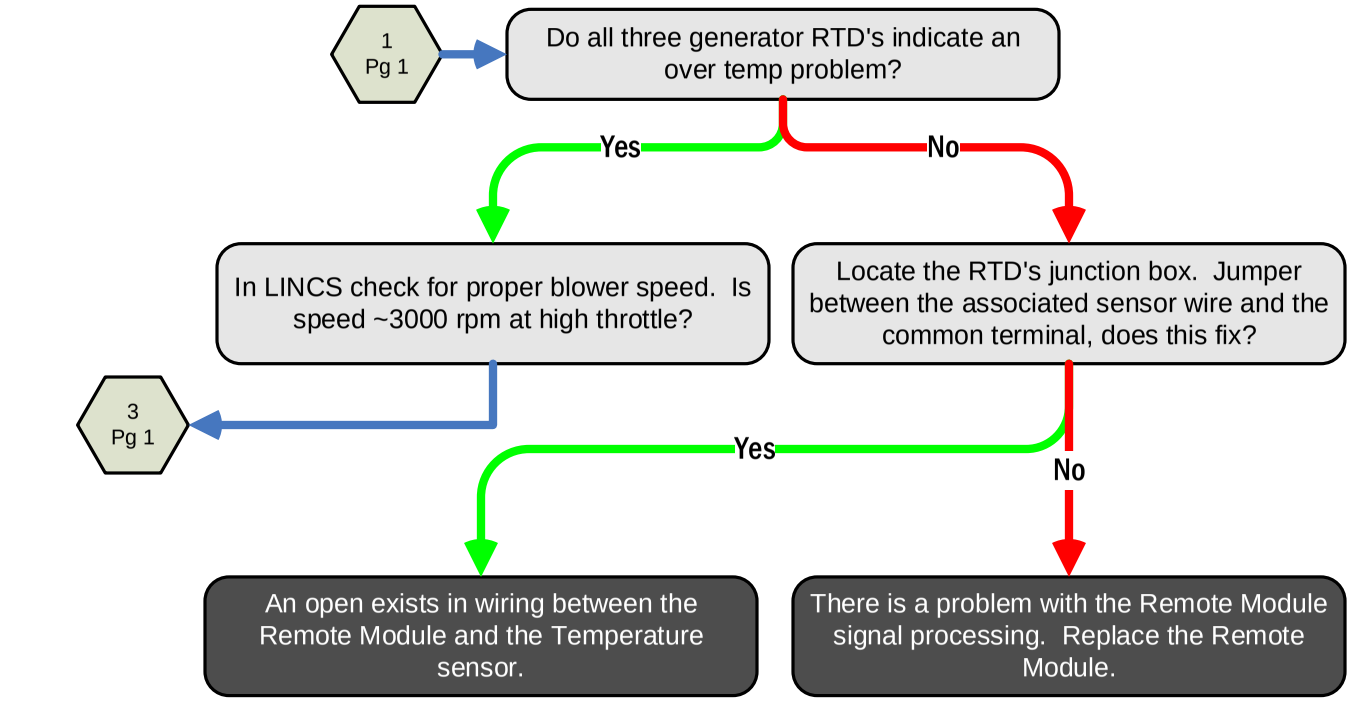

1
Pg 1
Do all three generator RTD's indicate an over temp problem?
Yes
No
In LINCS check for proper blower speed. Is speed ~3000 rpm at high throttle?
Locate the RTD's junction box. Jumper between the associated sensor wire and the common terminal, does this fix?
3
Pg 1
Yes
No
An open exists in wiring between the Remote Module and the Temperature sensor.
There is a problem with the Remote Module signal processing. Replace the Remote Module.

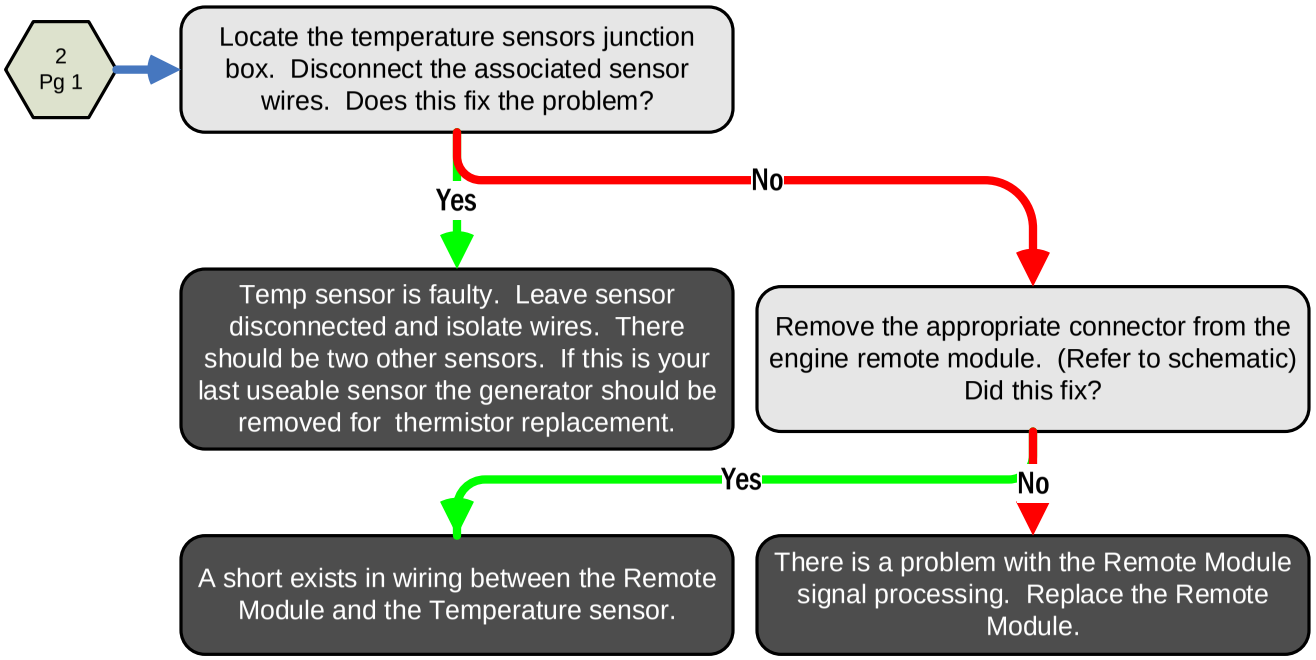

2
Pg 1
Locate the temperature sensors junction box. Disconnect the associated sensor wires. Does this fix the problem?
Yes
No
Temp sensor is faulty. Leave sensor disconnected and isolate wires. There should be two other sensors. If this is your last useable sensor the generator should be removed for thermistor replacement.
Remove the appropriate connector from the engine remote module. (Refer to schematic) Did this fix?
Yes
No
A short exists in wiring between the Remote Module and the Temperature sensor.
There is a problem with the Remote Module signal processing. Replace the Remote Module.

Generator Temperature Critically High

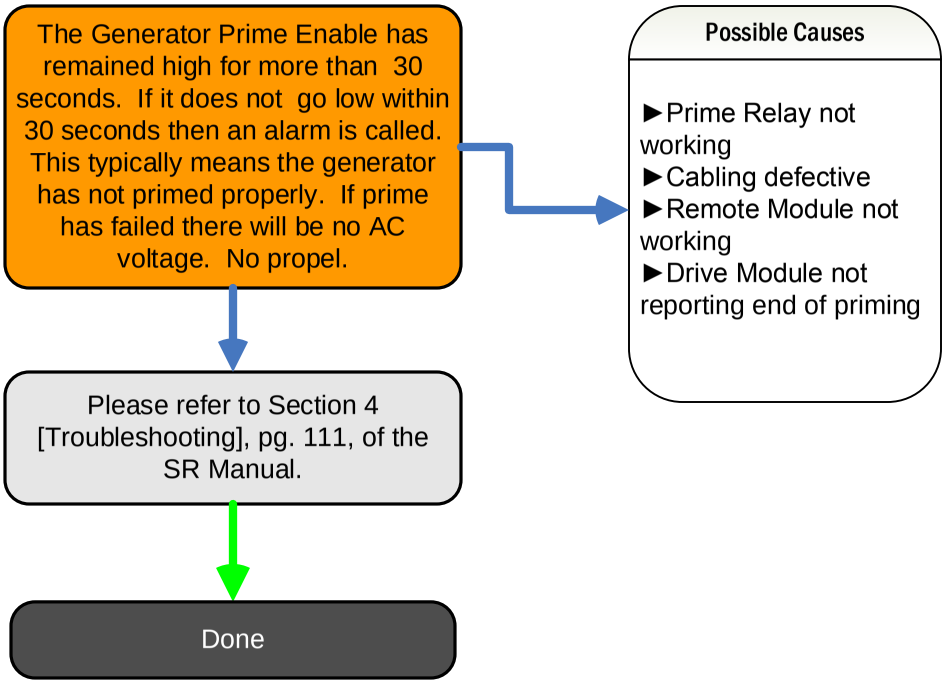
Electrical Symptom	8/30/2009	Page 1 of 2




1
Pg 1
Do all three generator RTD's indicate an over temp problem?
Yes
No
In LINCS check for proper blower speed. Is speed ~3000 rpm at high throttle?
Locate the RTD's junction box. Jumper between the associated sensor wire and the common terminal, does this fix?
3
Pg 1
Yes
No
An open exists in wiring between the Remote Module and the Temperature sensor.
There is a problem with the Remote Module signal processing. Replace the Remote Module.


2
Pg 1
Locate the temperature sensors junction box. Disconnect the associated sensor wires. Does this fix the problem?
Yes
No
Temp sensor is faulty. Leave sensor disconnected and isolate wires. There should be two other sensors. If this is your last useable sensor the generator should be removed for thermistor replacement.
Remove the appropriate connector from the engine remote module. (Refer to schematic) Did this fix?
Yes
No
A short exists in wiring between the Remote Module and the Temperature sensor.
There is a problem with the Remote Module signal processing. Replace the Remote Module.

Generator Prime Enable HI		
Electrical Symptom	8/30/2009	Page 1 of 1



Generator Control Fault Low

Electrical Symptom	9/9/2009	Page 1 of 2

If the command is more than 50VAC lower than the actual voltage for 2 seconds. Warning message only. No effect on operation.

Possible Causes

- ►Reading error
- ►6 phase transformer
- ►Cables with pin pushed out
- ►VR Interface card
- ►Drive module
- ►Loss of feedback
- ►Engine rpm not correct
- ►Loss of ±15V supply on SR interface board

Does the warning occur on when the Hydraulic Temperature is ≥ 170°F?

Yes

No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

Are there any other alarms or warnings active?

Yes

No

Fix these items first then restart the flowchart.

Use LINCS to examine the channel for Generator Voltage Command Echo. With the machine at High Throttle does LINCS report VGEN > 430VAC?

Yes

No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

With LINCS booted and the engine turned off, when it is safe to do so, open the Left Ladder Box and locate the VR/Prime Interface Card [located on the VR Panel]. Measure the following point referenced to ground [Conn 10, Pin 2]: +24VDC [Conn 10, Pin 1]; +15VDC [Conn 5:A, Pin 1]; -15VDC [Conn 5:A, Pin 2]. Do all voltages check good?

Yes

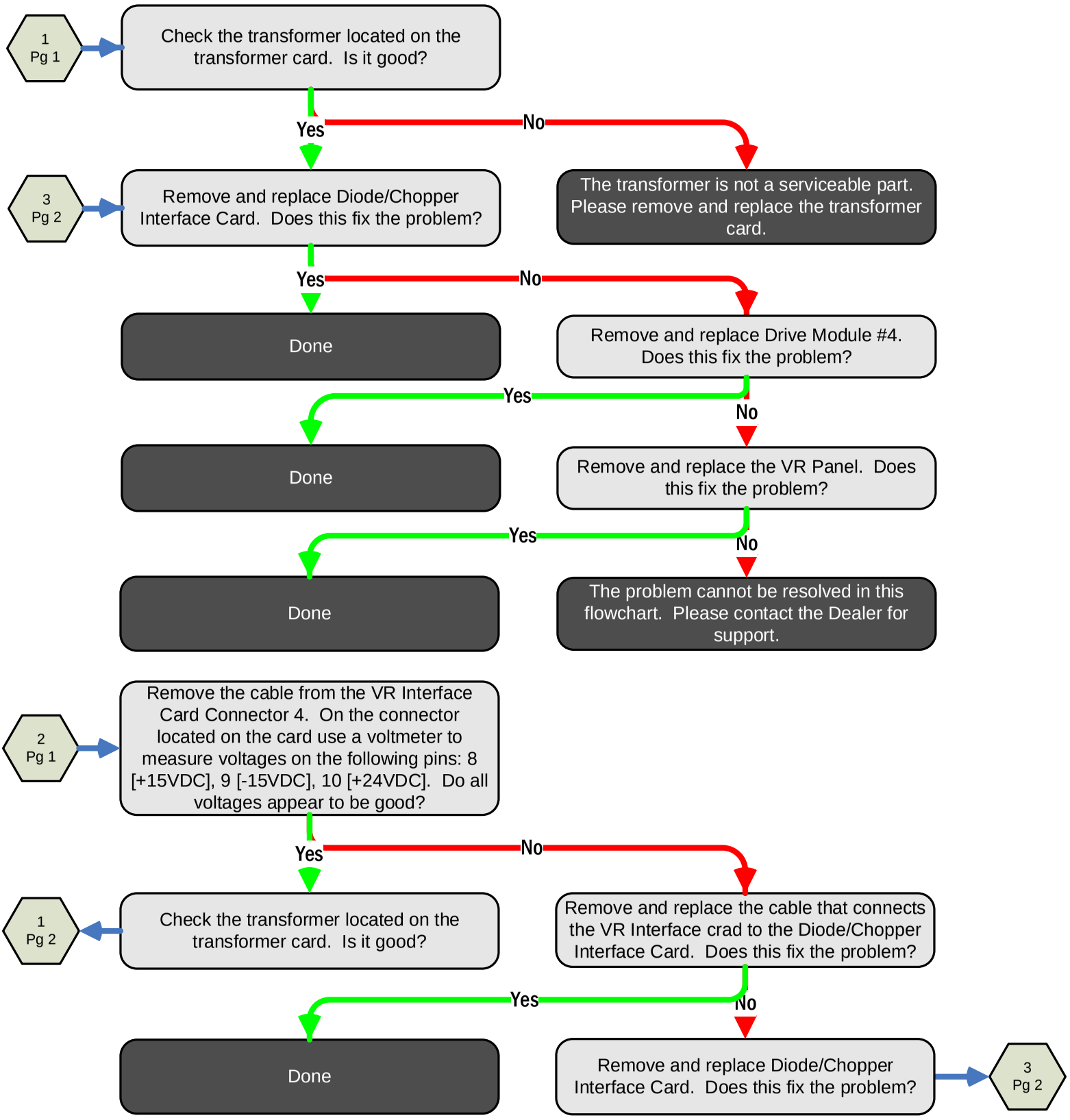
No

Remove the cable from the VR Interface Card Connector 4. On the connector located on the card use a voltmeter to measure voltages on the following pins: 8 [+15VDC], 9 [-15VDC], 10 [+24VDC]. Do all voltages appear to be good?

2 Pg 2

Check the transformer located on the transformer card. Is it good?

1 Pg 2


1 Pg 1
Check the transformer located on the transformer card. Is it good?
Yes
No
3 Pg 2
Remove and replace Diode/Chopper Interface Card. Does this fix the problem?
The transformer is not a serviceable part. Please remove and replace the transformer card.
Yes
No
Done
Remove and replace Drive Module #4. Does this fix the problem?
Yes
No
Done
Remove and replace the VR Panel. Does this fix the problem?
Yes
No
Done
The problem cannot be resolved in this flowchart. Please contact the Dealer for support.
2 Pg 1
Remove the cable from the VR Interface Card Connector 4. On the connector located on the card use a voltmeter to measure voltages on the following pins: 8 [+15VDC], 9 [-15VDC], 10 [+24VDC]. Do all voltages appear to be good?
Yes
No
1 Pg 2
Check the transformer located on the transformer card. Is it good?
Remove and replace the cable that connects the VR Interface crad to the Diode/Chopper Interface Card. Does this fix the problem?
Yes
No
Done
Remove and replace Diode/Chopper Interface Card. Does this fix the problem?
3 Pg 2

Generator Control Fault High

Electrical Symptom	9/9/2009	Page 1 of 2

Compares Generator Voltage Command Echo to Generator Voltage. If the commands is more than 50VAC higher than the actual voltage for 2 seconds. Warning message only. No effect on operation.

Possible Causes

- ►Reading error
- ►6 phase transformer
- ►Cables with pin pushed out
- ►VR Interface card
- ►Drive module
- ►Loss of feedback
- ►Engine rpm not correct
- ►Loss of ±15V supply on SR interface board

Does the warning occur on when the Hydraulic Temperature is ≥ 170°F?

Yes

No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

Are there any other alarms or warnings active?

Yes

No

Fix these items first then restart the flowchart.

Use LINCS to examine the channel for Generator Voltage Command Echo. With the machine at High Throttle does LINCS report VGEN > 430VAC?

Yes

No

The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

With LINCS booted and the engine turned off, when it is safe to do so, open the Left Ladder Box and locate the VR/Prime Interface Card [located on the VR Panel]. Measure the following point referenced to ground [Conn 10, Pin 2]: +24VDC [Conn 10, Pin 1]; +15VDC [Conn 5:A, Pin 1]; -15VDC [Conn 5:A, Pin 2]. Do all voltages check good?

Yes

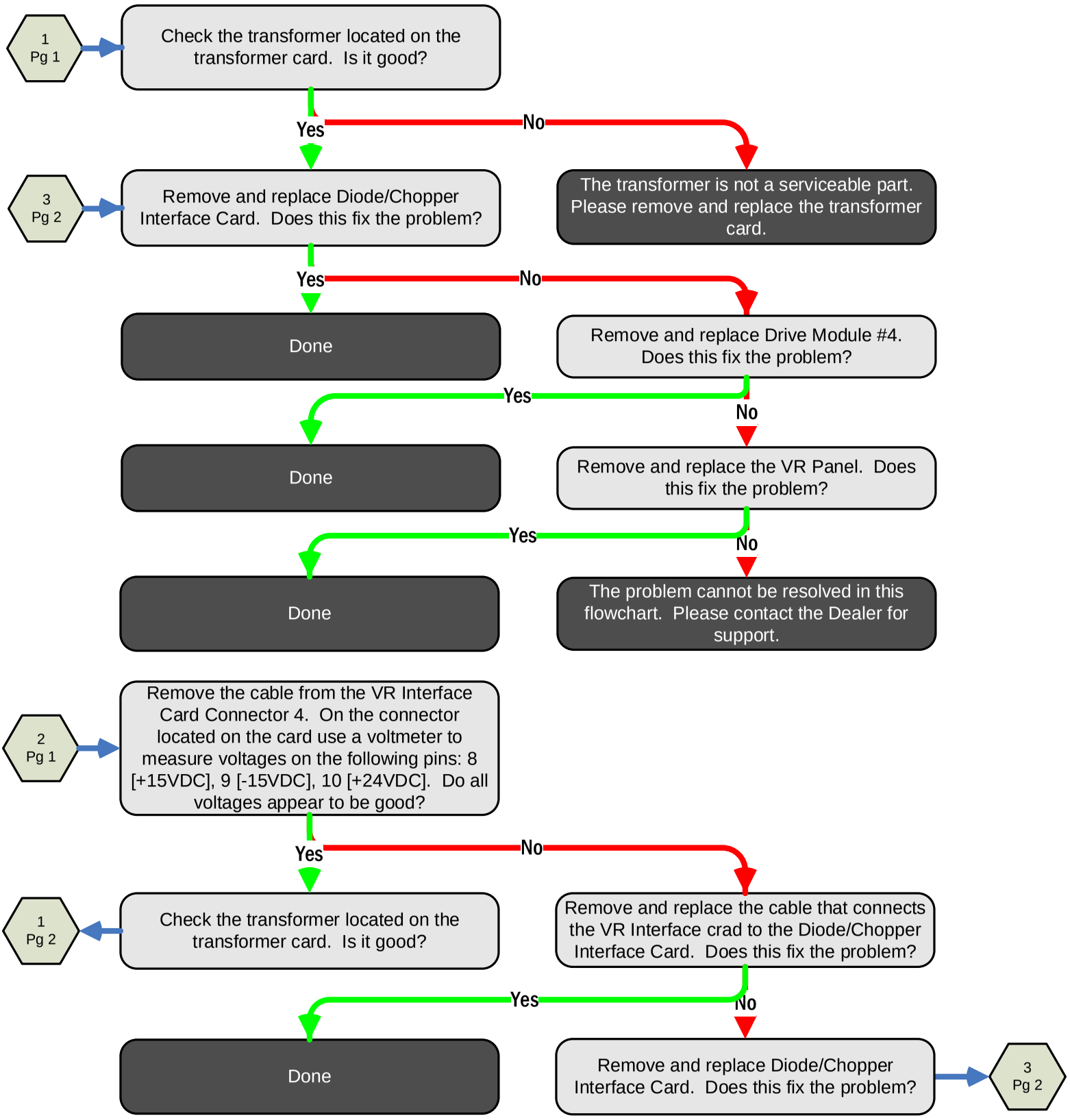
No

Remove the cable from the VR Interface Card Connector 4. On the connector located on the card use a voltmeter to measure voltages on the following pins: 8 [+15VDC], 9 [-15VDC], 10 [+24VDC]. Do all voltages appear to be good?

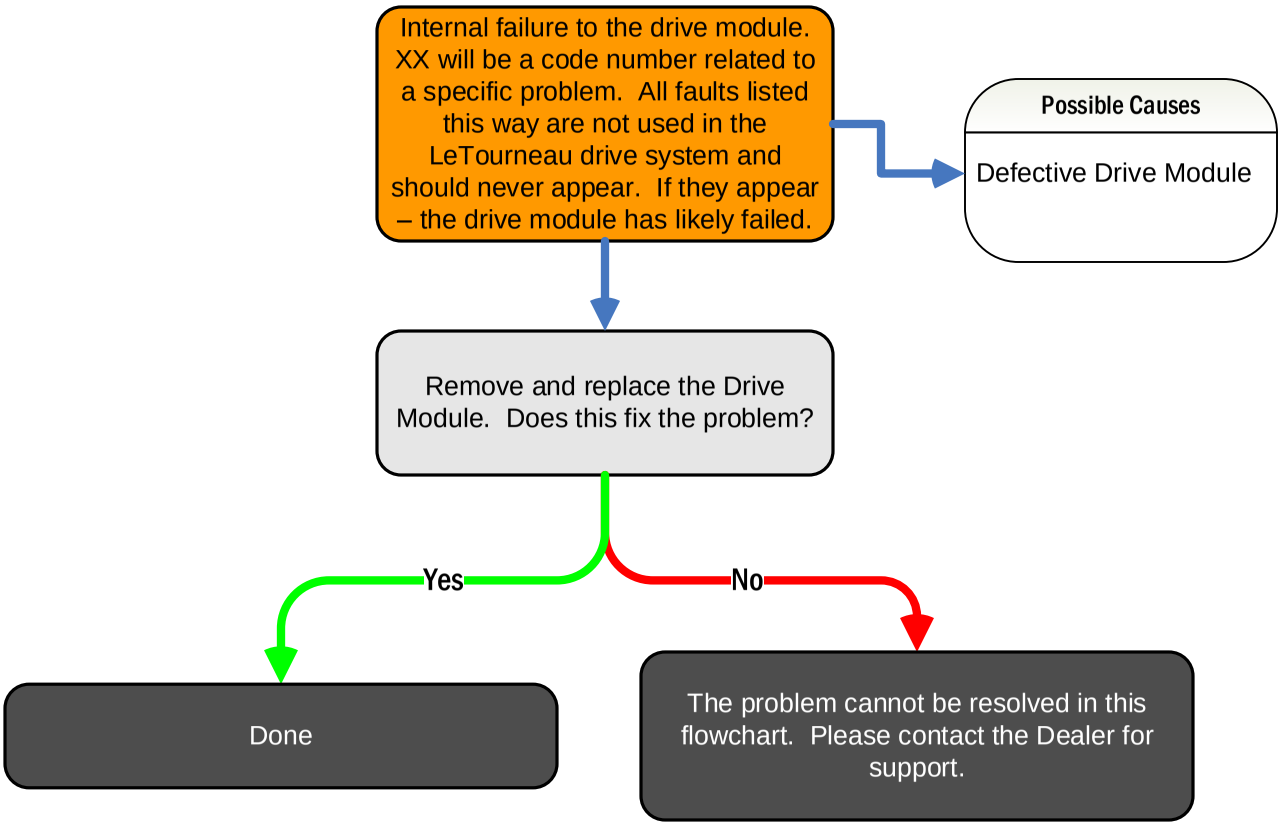
2 Pg 2

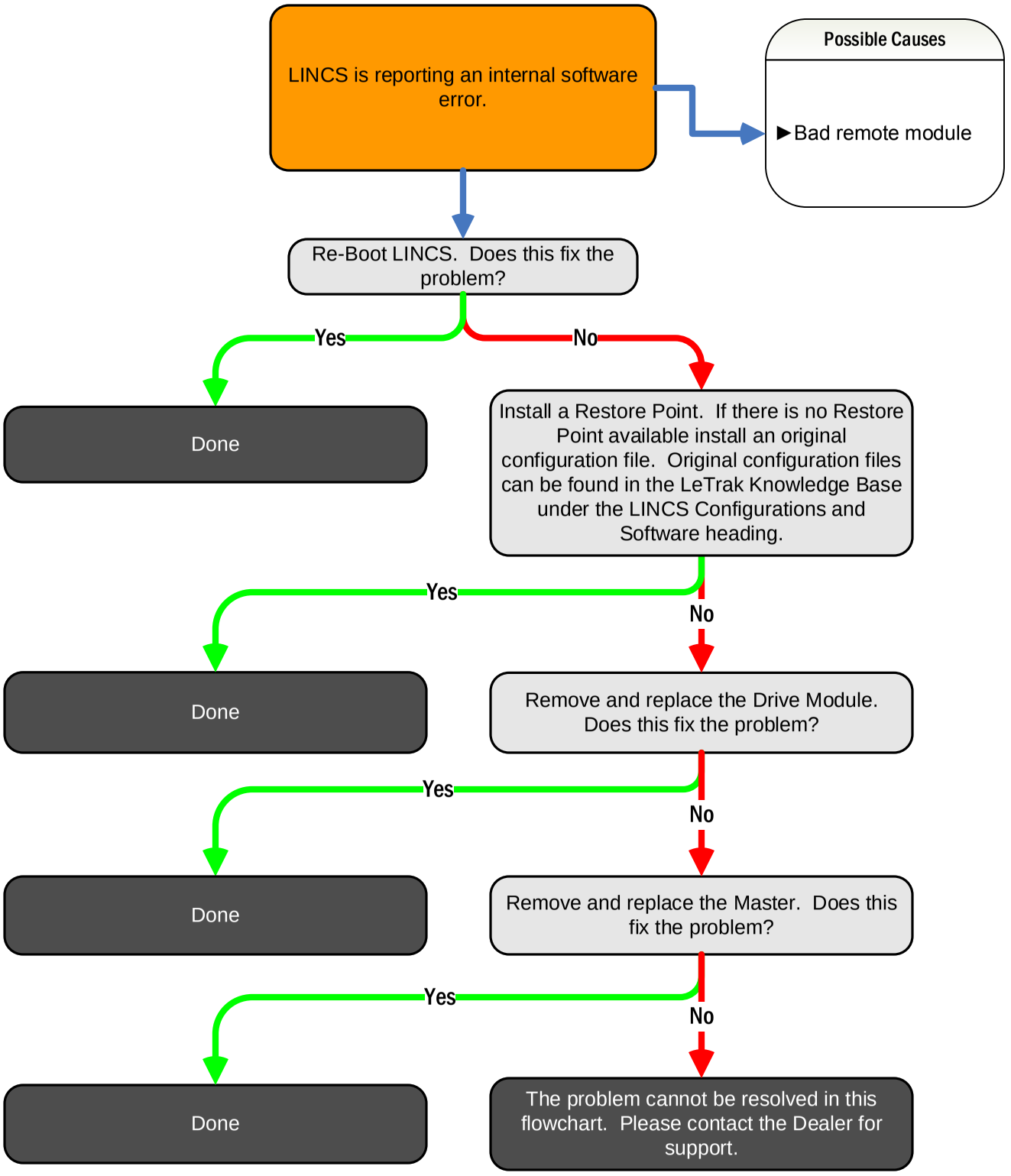
Check the transformer located on the transformer card. Is it good?

1 Pg 2


1 Pg 1
Check the transformer located on the transformer card. Is it good?
Yes
No
The transformer is not a serviceable part. Please remove and replace the transformer card.
3 Pg 2
Remove and replace Diode/Chopper Interface Card. Does this fix the problem?
Yes
No
Done
Remove and replace Drive Module #4. Does this fix the problem?
Yes
No
Done
Remove and replace the VR Panel. Does this fix the problem?
Yes
No
Done
The problem cannot be resolved in this flowchart. Please contact the Dealer for support.
2 Pg 1
Remove the cable from the VR Interface Card Connector 4. On the connector located on the card use a voltmeter to measure voltages on the following pins: 8 [+15VDC], 9 [-15VDC], 10 [+24VDC]. Do all voltages appear to be good?
Yes
No
1 Pg 2
Check the transformer located on the transformer card. Is it good?
Remove and replace the cable that connects the VR Interface crad to the Diode/Chopper Interface Card. Does this fix the problem?
Yes
No
Done
Remove and replace Diode/Chopper Interface Card. Does this fix the problem?
3 Pg 2

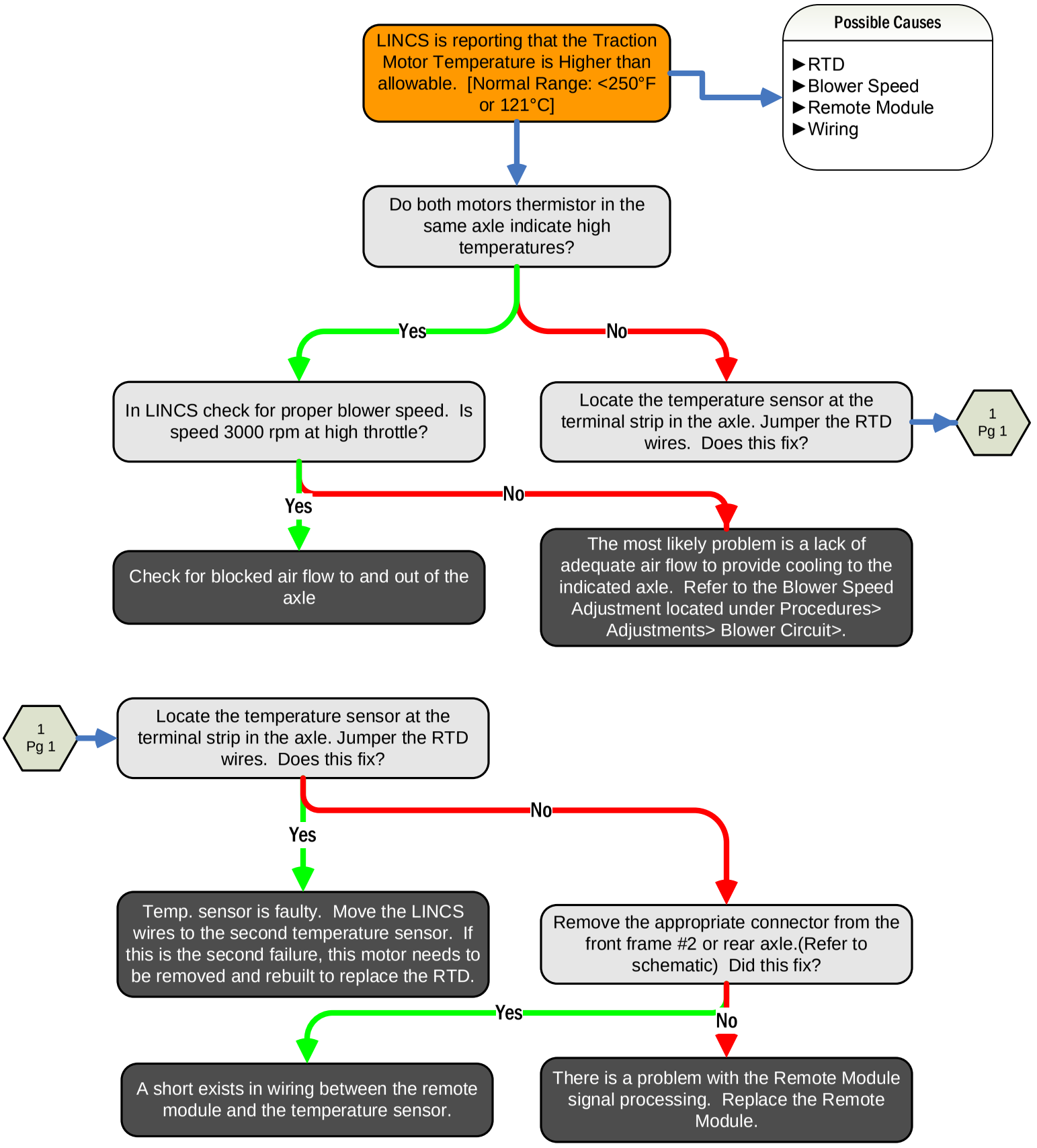
Internal Drive Fault		
Electrical Symptom	8/30/2009	Page 1 of 1




LINCS is reporting an internal software error.
Possible Causes
▶Bad remote module
Re-Boot LINCS. Does this fix the problem?
Yes
No
Done
Install a Restore Point. If there is no Restore Point available install an original configuration file. Original configuration files can be found in the LeTrak Knowledge Base under the LINCS Configurations and Software heading.
Yes
No
Done
Remove and replace the Drive Module. Does this fix the problem?
Yes
No
Done
Remove and replace the Master. Does this fix the problem?
Yes
No
Done
The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

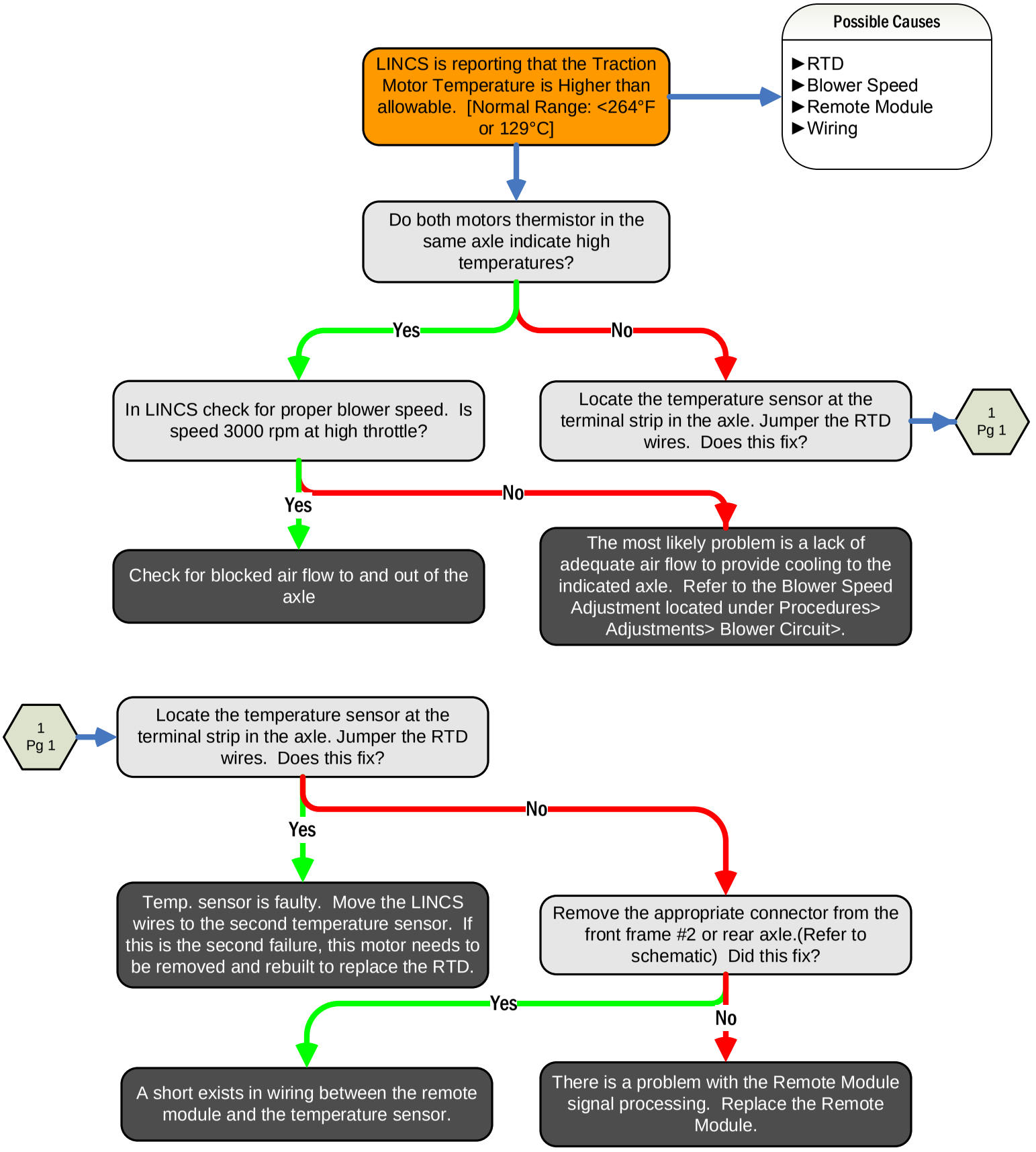
Motor Temperature High

Electrical Symptom	8/30/2009	Page 1 of 1



Motor Temperature Critically High

Electrical Symptom	8/30/2009	Page 1 of 1



Motor Disabled

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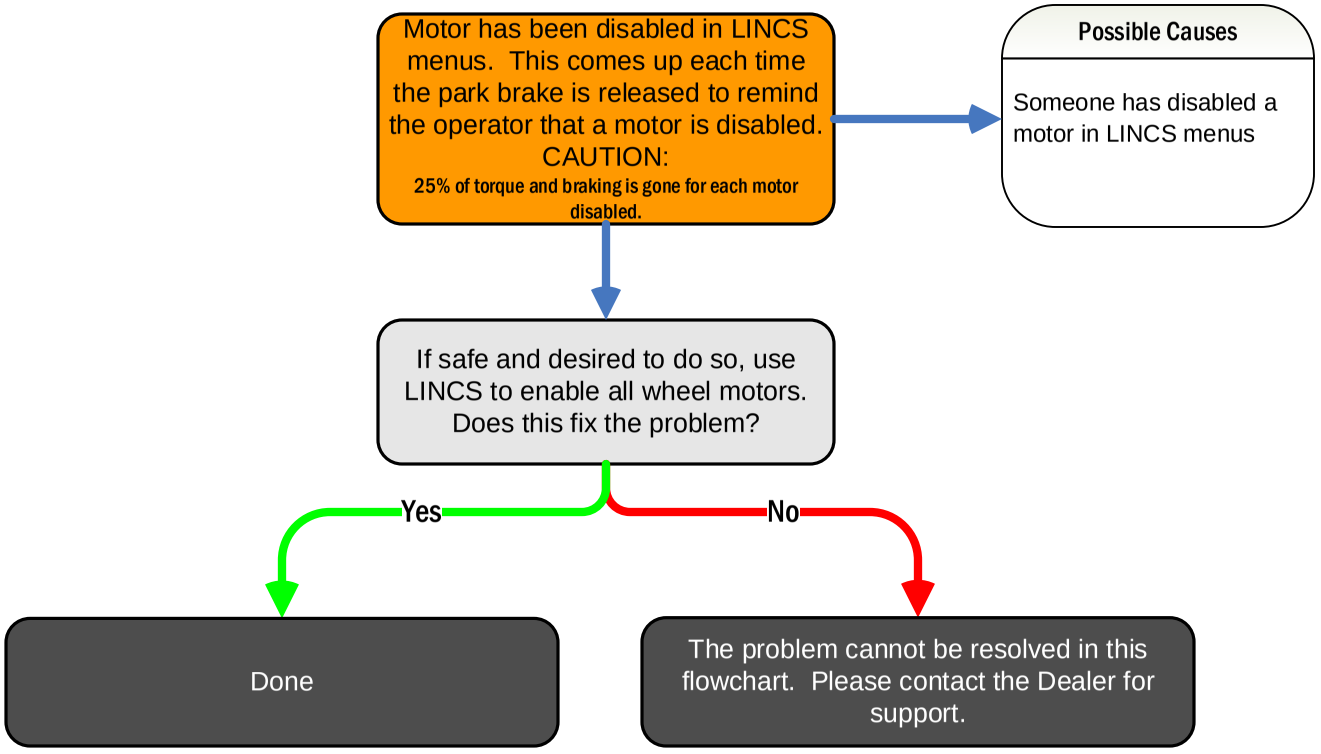
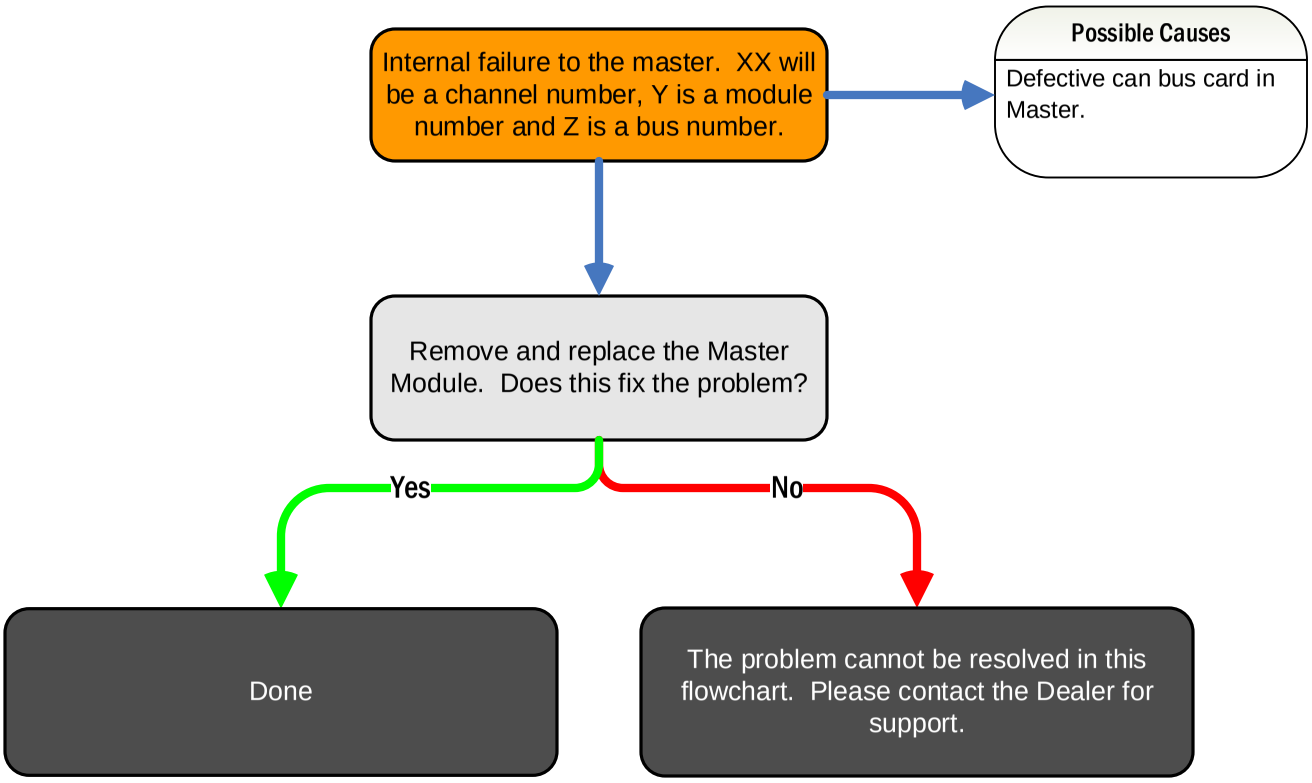
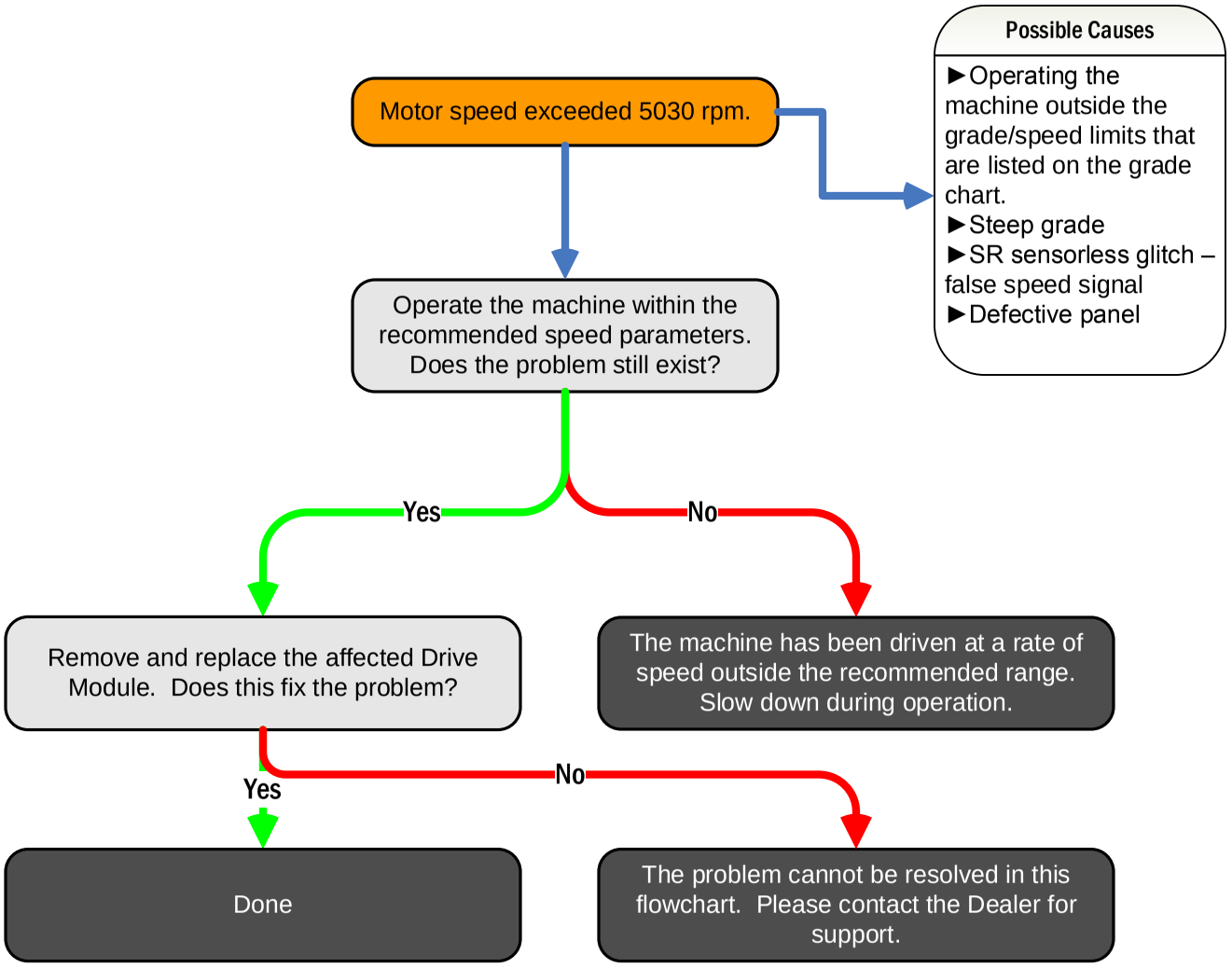
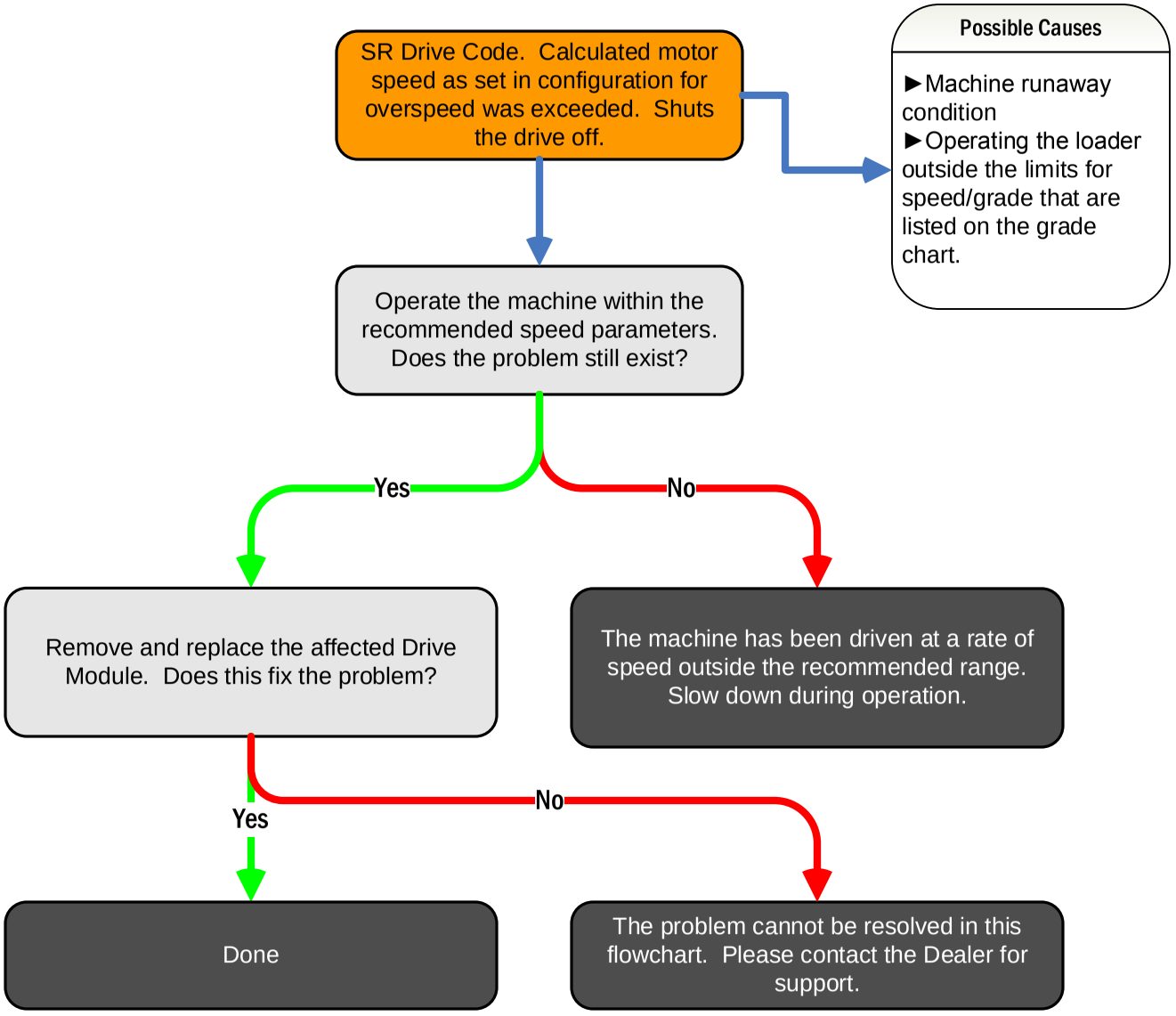


Master Bad Broadcast		
Electrical Symptom	8/30/2009	Page 1 of 1




Possible Causes
►Operating the machine outside the grade/speed limits that are listed on the grade chart.
►Steep grade
►SR sensorless glitch – false speed signal
►Defective panel
Motor speed exceeded 5030 rpm.
Operate the machine within the recommended speed parameters. Does the problem still exist?
Yes
No
Remove and replace the affected Drive Module. Does this fix the problem?
The machine has been driven at a rate of speed outside the recommended range. Slow down during operation.
Yes
No
Done
The problem cannot be resolved in this flowchart. Please contact the Dealer for support.


SR Drive Code. Calculated motor speed as set in configuration for overspeed was exceeded. Shuts the drive off.
Possible Causes
►Machine runaway condition
►Operating the loader outside the limits for speed/grade that are listed on the grade chart.
Operate the machine within the recommended speed parameters. Does the problem still exist?
Yes
No
Remove and replace the affected Drive Module. Does this fix the problem?
The machine has been driven at a rate of speed outside the recommended range. Slow down during operation.
Yes
No
Done
The problem cannot be resolved in this flowchart. Please contact the Dealer for support.

Remote I/O Power Low

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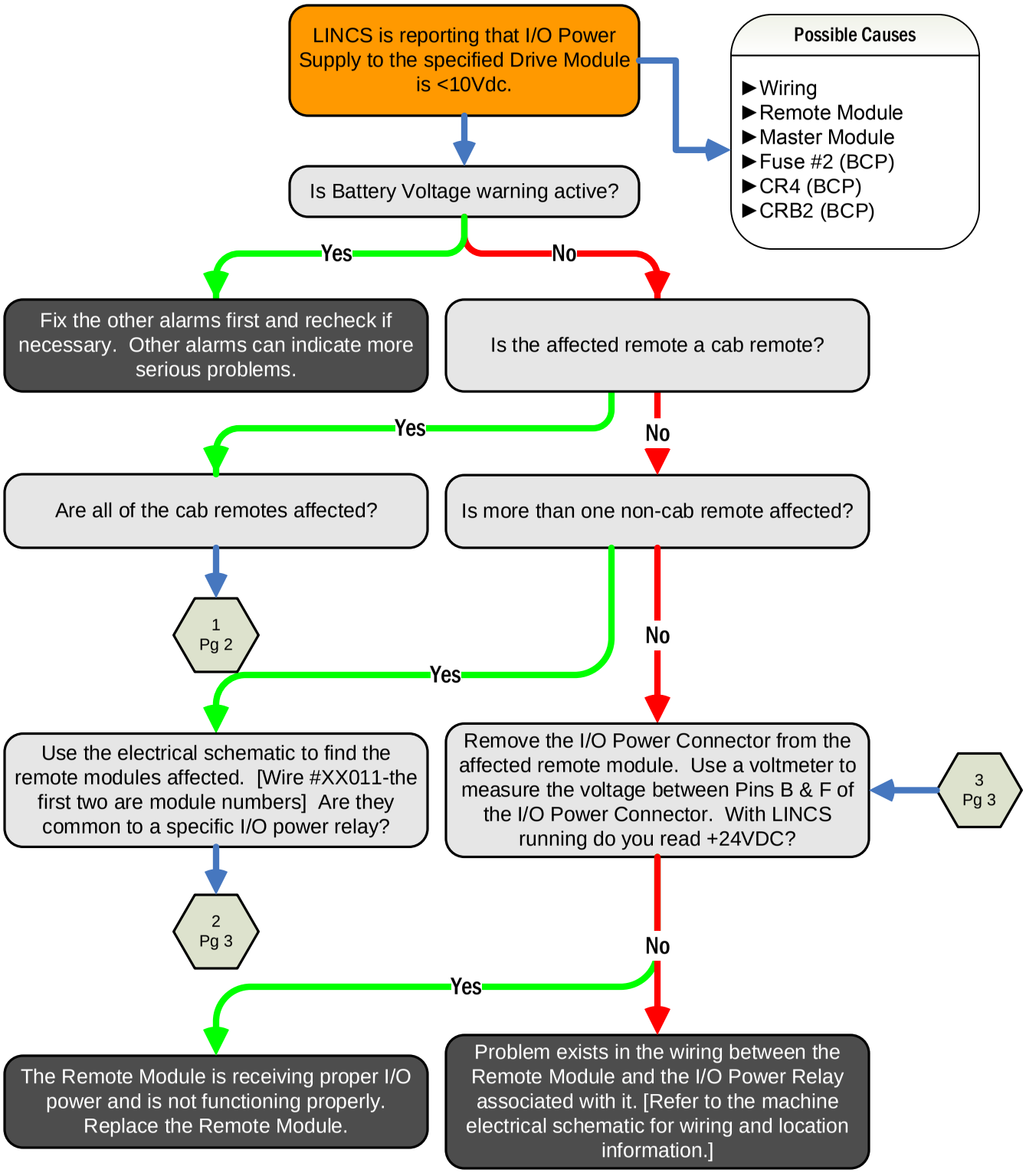
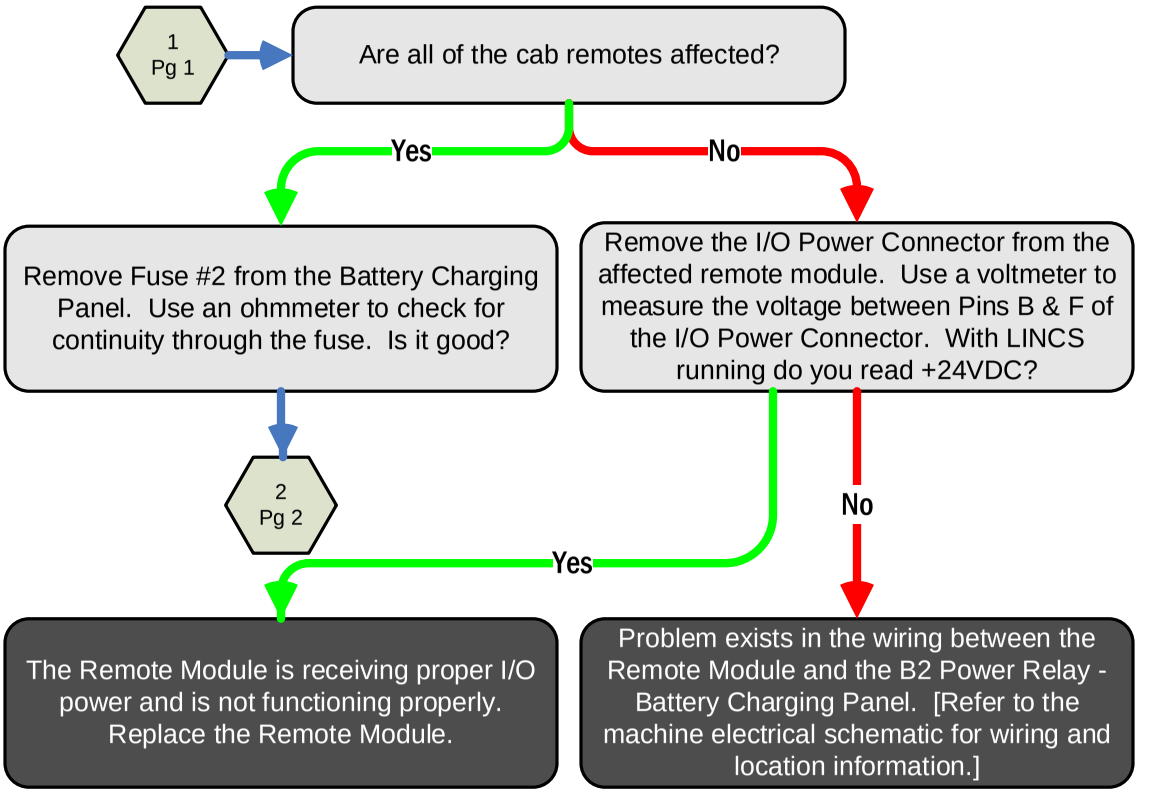
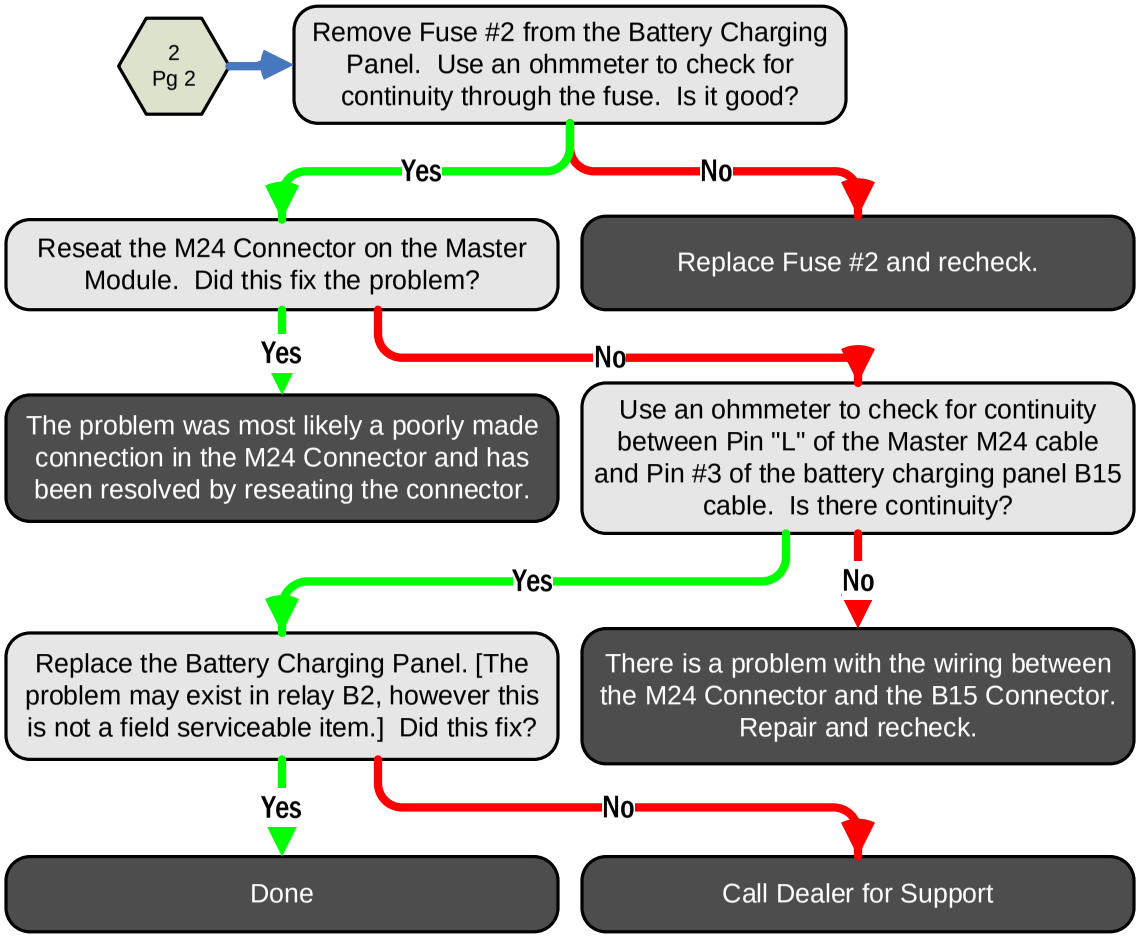
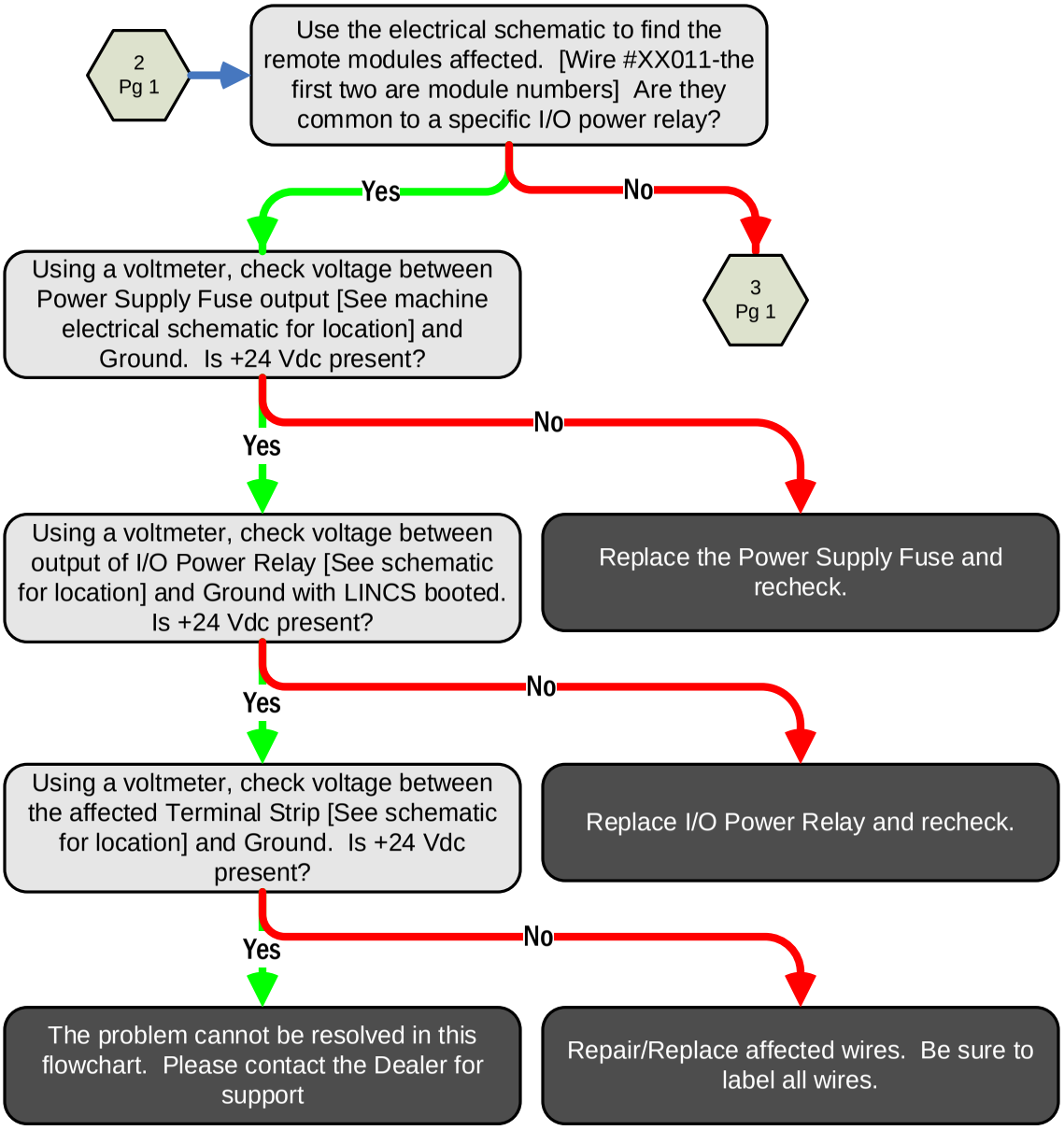



1
Pg 1
Are all of the cab remotes affected?
Yes
No
Remove Fuse #2 from the Battery Charging Panel. Use an ohmmeter to check for continuity through the fuse. Is it good?
Remove the I/O Power Connector from the affected remote module. Use a voltmeter to measure the voltage between Pins B & F of the I/O Power Connector. With LINCS running do you read +24VDC?
2
Pg 2
No
Yes
The Remote Module is receiving proper I/O power and is not functioning properly. Replace the Remote Module.
Problem exists in the wiring between the Remote Module and the B2 Power Relay - Battery Charging Panel. [Refer to the machine electrical schematic for wiring and location information.]


2
Pg 2
Remove Fuse #2 from the Battery Charging Panel. Use an ohmmeter to check for continuity through the fuse. Is it good?
Yes
No
Reseat the M24 Connector on the Master Module. Did this fix the problem?
Replace Fuse #2 and recheck.
Yes
No
The problem was most likely a poorly made connection in the M24 Connector and has been resolved by reseating the connector.
Use an ohmmeter to check for continuity between Pin "L" of the Master M24 cable and Pin #3 of the battery charging panel B15 cable. Is there continuity?
Yes
No
Replace the Battery Charging Panel. [The problem may exist in relay B2, however this is not a field serviceable item.] Did this fix?
There is a problem with the wiring between the M24 Connector and the B15 Connector. Repair and recheck.
Yes
No
Done
Call Dealer for Support


2
Pg 1
Use the electrical schematic to find the remote modules affected. [Wire #XX011-the first two are module numbers] Are they common to a specific I/O power relay?
Yes
No
3
Pg 1
Using a voltmeter, check voltage between Power Supply Fuse output [See machine electrical schematic for location] and Ground. Is +24 Vdc present?
Yes
No
Replace the Power Supply Fuse and recheck.
Using a voltmeter, check voltage between output of I/O Power Relay [See schematic for location] and Ground with LINCS booted. Is +24 Vdc present?
Yes
No
Replace I/O Power Relay and recheck.
Using a voltmeter, check voltage between the affected Terminal Strip [See schematic for location] and Ground. Is +24 Vdc present?
Yes
No
Repair/Replace affected wires. Be sure to label all wires.
The problem cannot be resolved in this flowchart. Please contact the Dealer for support

Voltage Regulator Heat Sink Temp High

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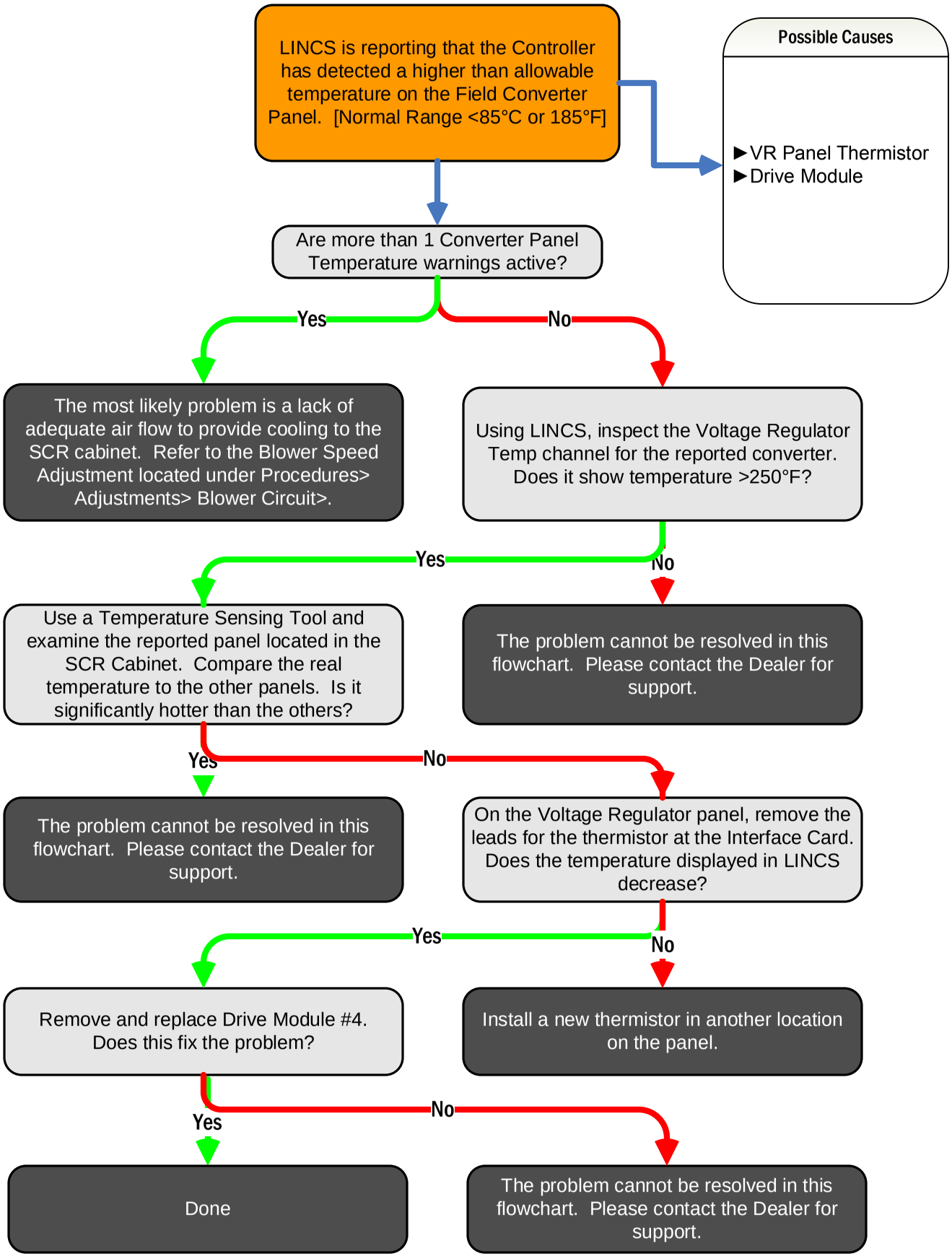

VR Fuse Status Blown

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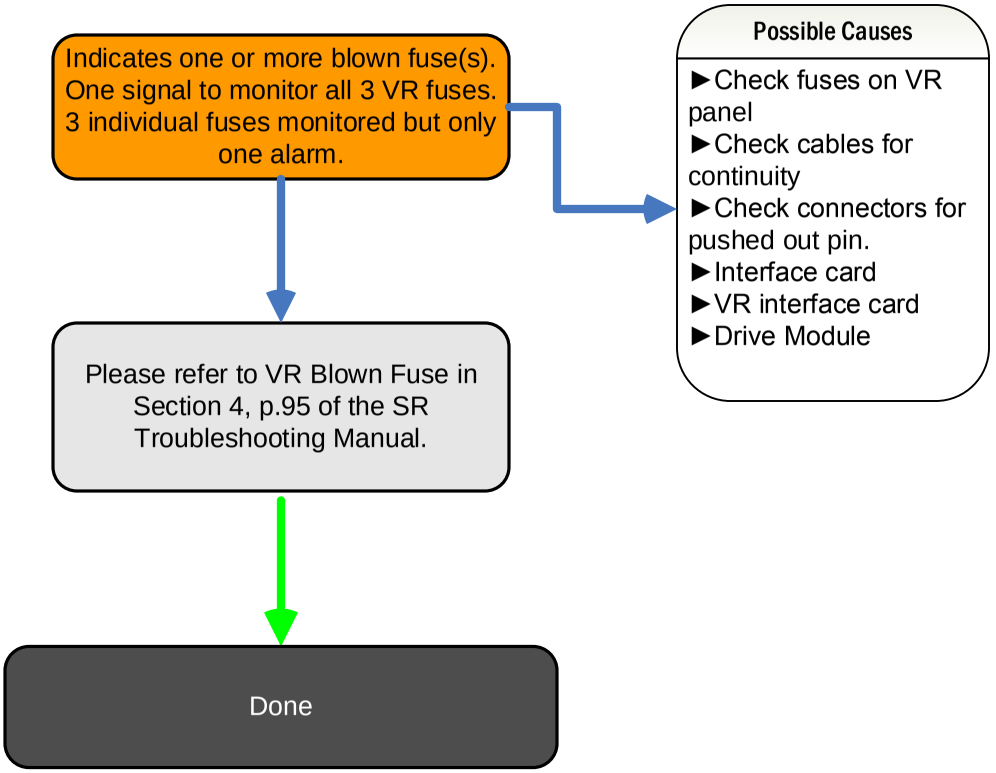

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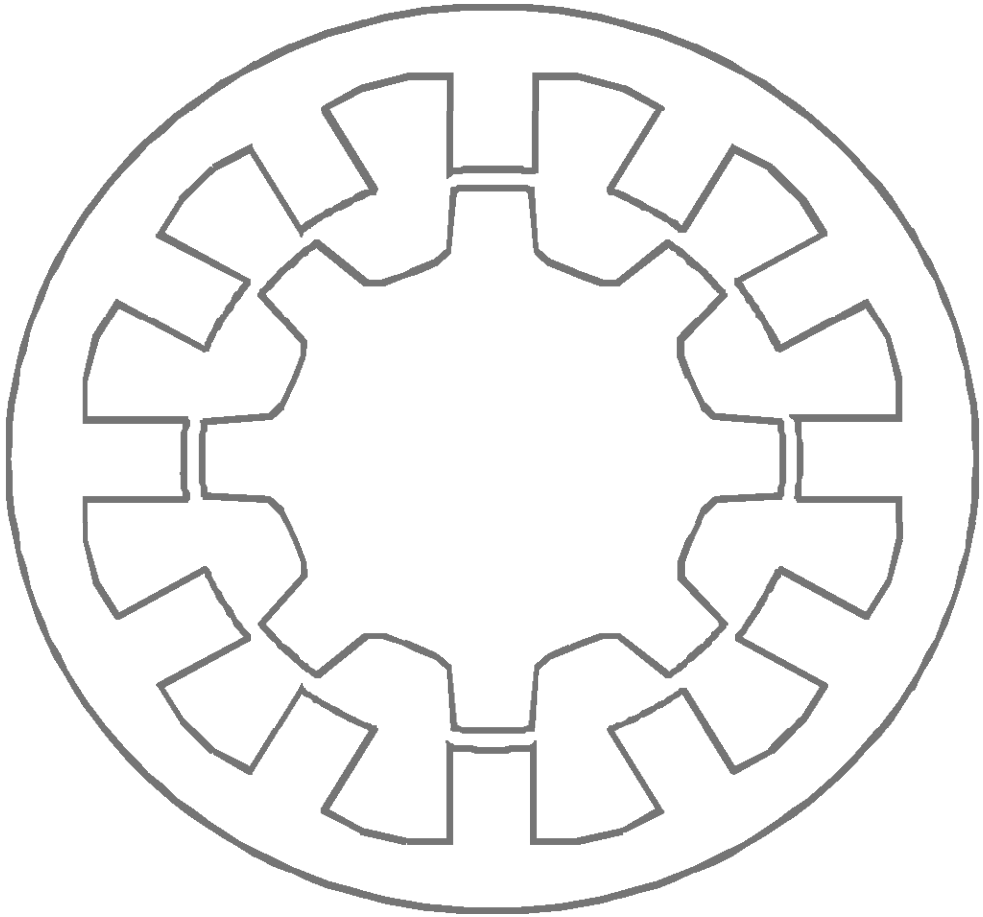
50 Series Diagnostic Tool



REMOVAL INSTALLATION

Removal / Installation

LeTourneau Technologies, Inc.

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